RAVEL

AIR, LAND, AND SEA

SON HART WEBSTER

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Airplanes are our newest means of travel. American airways reach thirty-two countries. What other means of transportation can you mention?

The Social Studies Series

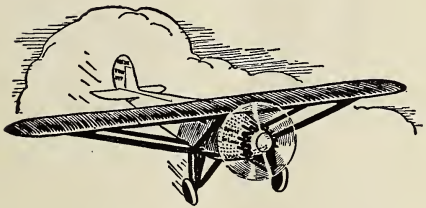
TRAVEL

by Air, Land, and Sea

BY

HANSON HART WEBSTER

Author of "The World's Messengers"
Co-Author of "The Ship Book"



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EDITOR'S INTRODUCTION

THE social studies seem now to be firmly established as a serviceable part of our school programs. In connection with the development of these studies, many investigations in reading and curriculum problems have been made. From the teachers' viewpoint these have demonstrated the need for wider experiential reading for the boys and girls. As a result of the growing attention to the interests of the children themselves has come an increasing demand for pertinent facts drawn from the social sciences and presented in form suitable for young readers.

Modes of travel and transportation are of almost constant interest to both boys and girls. This book is offered with the confident expectation that its subject matter will appeal. It is believed, too, that it presents in an attractive and readable way the most significant facts about how people travel and how they transport their goods today, and that an adequate historical background is furnished.

The approach to the subject conforms to current procedures in presentation of materials for children. Each of the five parts into which the book is divided begins with the familiar vehicles of today, and then traces the course of their development back to the less familiar vehicles of earlier times. Opportunity is afforded for children to understand the influence of such inventions as the locomotive, the steamship,

the automobile, and the airplane in the development of modern travel and transportation.

The book shows how men and women in strange corners of the earth have always done as well as they could with the materials they have had at hand; and how, usually, these people have been eager to adopt the inventions introduced to them by visitors from more advanced countries.

It brings out the truth that our modern machines have grown from very small beginnings, and that they have been developed through the persistence and co-operation of men of many different nationalities. Dramatic episodes are woven into the narrative with the purpose of bringing into relief the more significant inventions and achievements.

It helps children to realize that the world is growing smaller and to arouse in them the desire to know more about the people of other lands than their own. Instances of neighborly understanding, neighborly interdependence, and neighborly helpfulness are introduced because these help children to appreciate the meaning and the value of world friendship.

New plans for the selection and organization of curriculum materials have served as guides in the choice of topics; reports on transportation facilities have been canvassed for the latest facts; and the spontaneous questions of boys and girls with whom the author has traveled in automobiles, trains, steamships, and airplanes have been noted, and an attempt has been made to answer them.

The volume may be used effectively in programs in the social studies in progressive schools. Many

opportunities are provided for correlations with geography and history. It is also the hope of both the author and the editor that boys and girls will enjoy reading the book without regard to its usefulness in school.

WILLIAM G. KIMMEL

Introduction

WHAT TRANSPORTATION MEANS

How are things from far-away places brought to us? — How the world is growing smaller — Improvements in transportation since Washington's time — The newest ways of travel.

BEFORE you begin to read this book, look around the room for a moment and see whether you can tell where some of the things in it were made, and how they were brought to us. You will be surprised when you find how far some of them have traveled. If they could talk, they could tell interesting stories about how their journeys began, and the different ways in which they have been carried. Perhaps, after you discover where these things were made, you can write a story yourself that tells about their travels from some far-away place to your own home.

Have you ever happened to think that every hour of the day and night, people all over the world are working to bring food, clothing, and other things that we use day by day? Trains rush along the railroad tracks, motor trucks speed over the highways, steamships plough the ocean, and airplanes and dirigibles fly through the air.

In out of the way corners of the earth, camels, elephants, oxen, mules, donkeys, and even dogs carry goods from one place to another. In some lands men and women carry loads themselves. In others they use horses and the same sort of carts that have been used for hundreds of years. The

work of all of these is called "transportation," a word which means the carrying of passengers and freight from place to place.

We often hear it said that the world is becoming a very small place and that nowadays all countries are near neighbors. This means, of course, not that the earth is changing in size, but that the new ways of transportation are faster than the old ways. It means too, that now people can go to parts of the world which years ago they could not reach. It means also that travelers feel better acquainted with the people of far-away lands, and think of them as friends and not as strangers.

It is worth remembering that George Washington was deeply interested in everything connected with improvements in transportation. He was one of the first men in America to suggest the digging of a canal on which boats could travel. This was between the Potomac and the James Rivers in Virginia. Washington was the very first to urge the building of a road from the Atlantic Coast to the Ohio River. Thus, he said, journeys could be made across our country, part way by coaches and the rest of the way by boats. In those days the Mississippi River was our western boundary. The map shows you how the Ohio River flows into the Mississippi. Washington knew about the first experiments with steamboats and about the first balloons which were tried in France. He believed that both inventions would prove valuable to the people of the United States.

Julius Cæsar was a famous Roman ruler about

whom you will read in many books. He died nearly seventeen hundred years before Washington was born. If, however, he could have visited New York City on the day that Washington was made our first President, he would have seen no means of transportation that he could not understand. Horses and wheeled vehicles were well known to the Romans, and they were the only means of land travel that Washington used.

But if Washington were to come to New York today, less than a hundred and fifty years after he was made President, he would see people traveling in all sorts of ways which he could not understand at all. He would see almost no horses. Can you name all the kinds of transportation that he might see?

This book tells about the different kinds of transportation, old and new, in many lands. It begins with stories about airplanes and dirigibles because these are the newest means of transportation of all, and everyone is interested to know what these aircraft have already done, and what we can expect them to do in the future.

Everyone has many questions to ask. If you have heard an airplane spoken of as a "heavier-than-air" flying machine, have you wondered what kept it from falling? If a dirigible balloon is "lighter than air," can you imagine how it is brought back to earth?

We shall find answers to other questions, too. For example, "What is the difference between an airplane and a dirigible?" "Why does a dirigible

need an engine?" "How did the first airplanes look?" "What are some of the most famous flights ever made?" "Who are some of the most famous fliers?"

The more you learn about flying, the more interested you will be. Perhaps, some day, you will invent something that will be helpful in transportation by air. Perhaps you will become a great flier yourself. Why not?

WHAT TO READ

"Moving the World from Door to Door." J. D. Mooney. *Home Geographic Monthly*, vol. 1, no. 3, March, 1931.

Pertaining to Transportation. Doris Rosenthal.

More than 100 drawings illustrating the growth of land and water transportation from long ago to now.

The Picture Book of Travel. Berta and Elmer Hader.

Tells about all sorts of an mals and all sorts of vehicles used at home and in far corners of the earth.

The Story of Transportation. Jeanette Eaton.

How men have traveled, from the earliest times to the present.

About Airplanes and Dirigibles

WE VISIT AN AIRPORT

An airplane ride — An up-to-date airport — A chat with an airman.

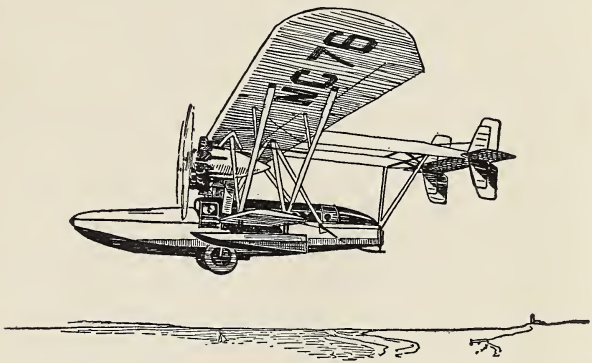
THE other day a boy about as old as you are had his first ride in an airplane. He says that it was the most exciting thing that he ever did, and his story about it makes his friends eager to fly too. Here is the story of his ride as he told it for this book.

"One afternoon last summer Mother and Daddy and I went to a hotel where many scientists were having a convention. Across the road was a beach, and in the harbor beyond were a lot of interesting boats. There was a submarine, and there were cruisers, motor boats, and sailboats. The most interesting thing of all was an amphibian.

"An amphibian is a flying machine that can take off and land on either water or dry ground. Its landing gear has pontoons so that the plane can float on the water. It also has wheels and skids so that it can run along the ground before it goes into the air, or after it comes down.

"We watched the amphibian taking people for short rides. It started from the beach. The propeller in front was made to revolve very fast so that it pulled the machine across the beach and out upon the water. There the propeller went even faster, and soon the amphibian was rushing along, throwing up a great wave. We could not tell when it skimmed

up from the surface of the water unless we noticed when the wave disappeared. The first thing we knew, the big machine was in the air, going higher and higher.



An amphibian. She has two engines and can carry ten passengers besides baggage and mail.

"After fifteen minutes or so it came back, slanting down little by little toward the water. When it touched the surface, it kicked up a big wave, but soon it slowed down and came close to the beach. Then it climbed back upon the sand, looking for all the world like some strange sea monster wading up out of the water. The wheels were its feet.

"An officer asked us if we would like to try flying. You may be sure that we did not take long to decide. When we took our seats in the amphibian, we found that inside it looked very much like the inside of our automobile. There were the same kinds of seats, but more of them, and the same

kinds of doors and windows. We had to climb up a sort of stepladder, though, to get in, for the wheels were nearly as tall as a man.

"We were told to shut the doors and windows tight, because otherwise, when we dashed through the waves, the spray would come in and drench us. We rolled down across the beach and through the waves, right out into the water, where we skimmed along exactly as if we were in a motor boat. The roar of the propeller was so loud that we had to shout into each other's ears to make ourselves heard.

"All of a sudden, when we looked out of the window, we saw that we were really going up. We looked down on the masts and funnels of a cruiser, and it seemed as if she was tipping over. This was because the amphibian was rising into the air in a long slope, so everything seemed to be on a slant.

"Below, we saw the sea gulls and the long, foamy lines of breaking waves. Then we passed over islands and capes, and looked down on roads full of automobiles, on church towers, the roofs of houses, and woods and fields. We were surprised that we did not seem to be moving very fast. Daddy looked at a dial in front, between us and the pilot who was flying the plane, and said, 'Why, we are traveling ninety miles an hour!' We were a thousand feet up in the air, and of course there were no telegraph poles or trees or anything else to watch as we went by, so we did not feel the speed as we do in an automobile that is traveling only half as fast.

"Our ride was over all too soon. We came sloping back toward the starting place. The engine was

slowed down and we landed upon the water with hardly a splash. Then the amphibian waded up on the beach again, and we had to let other people take our seats. I hope that some day soon you may go for an airplane ride. If I were you, I think I should choose an amphibian."

Let us suppose that we are ready to "take the air" as the aviators say. How can we know that the airplane we choose for our ride is a safe one, and that the pilot is skillful and careful? We must be sure to go to a well-managed airport, for there we shall find only machines and pilots that are approved by the Government. Any machine that carries the letters "C" or "NC" and a license number has been examined by the United States Department of Commerce, and is known to be a safe one. "C" means that a plane may be used in commerce within the limits of the United States. "NC" stands for "National Commercial" and means that the plane may be used outside of our country.

In some of our States no airplane is allowed to fly unless it has been examined by State officers as well as by agents of the National Government. These planes carry the letter "S" and a number. Planes that are used in racing and in experimental work have their own letters, "AC" "NX" "W" for example, or special symbols. They are numbered, too. What ones have you seen?

Let us visit an up-to-date airport and learn what is done to keep air travel safe. We can pick out the airplane that suits us best, and before we take the air, we can talk with the pilot and find out many

things about flying that everyone ought to understand.

The airport, we find, is out in the open country several miles from the city. Fliers always wish to do their taking off and their landing where there are no trees, tall chimneys, or electric wires and poles to bother them. So airports, whenever it is possible, have wide level fields far away from any of these things.

Out in the middle of the airport is the landing field, with eight long roads, smooth and wide, called runways. This is where the airplanes land and where they take off. From the air the roads look like an immense wheel with eight spokes. At the center is a big circle like the bull's-eye in a target. This is the spot the airplanes aim at when they are ready to land. As they come closer to the ground, they turn so that they can run along whichever one of the roads has the wind blowing in the right direction. An airplane, as perhaps you know if you have flown model machines, must always fly straight against the wind both when taking off and when landing.

The edges of the field are outlined with border lights standing on low posts painted either yellow, or yellow with black stripes. These colors are more easily seen from the air than any others. At night the lights shine straight upward. They may be yellow, blue, green, or violet because these colors are not often used in other places. When they see them, pilots know that they mark an airport.

Beyond the border lights, and on higher posts, are the flood lights. These throw their beams down

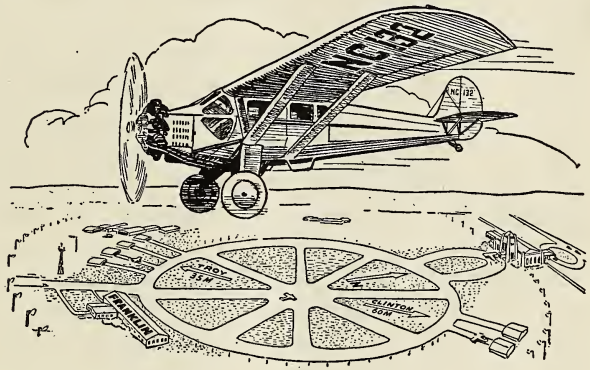
toward the ground. There are many of them, and after dark the surface of the field is brightly lighted everywhere. Some of them light up also, as a guide to the pilots, the buildings and hangars surrounding the field.

How passengers go aboard an airplane.

One of the most important lights on the landing field is the great revolving beacon which flashes a signal first in one direction and then in another. The flashes are made regularly and are in a code, which spells out for the pilots the name of the place. The light from a beacon can be seen many miles away.

Another important light is the one that is thrown upon the wind tee or vane, for a pilot must always know the direction from which the wind is blowing. The wind vane may be a big yellow-and-black arrow which swings on the top of a high pole, or it

may be what is called a wind cone, or a wind sock. Perhaps this last name will help you to guess what sort of thing a wind cone is. You may have seen a small one at the bow of a steamer or at the masthead of a sailing vessel. It is a long, narrow, pointed bag shaped a little like a stocking. The larger end is held open by a ring, so that the wind sock is always full of air and always blows away from the wind.



A monoplane of today. She is much like Colonel Lindbergh's The Spirit of St. Louis. Far below her we see an airport.

Some landing fields have wind tees with rows of neon lights. They signal not only the direction of the wind, but also how many miles an hour it is blowing. Neon lights can be seen even through fog and so are better in this sort of signaling than electric lights whose rays cannot pierce fog for any great distance. You know what neon lights are

if you have noticed the new kinds of advertising signs that have become so common recently. The bulbs are filled with neon gas, which glows brightly when electricity flows through it.

Around the edge of the landing field are the hangars, or sheds in which the airplanes are sheltered between flights. They have fuel tanks, repair shops, chemical fire engines, and sometimes classrooms where young men and young women can take a course in ground flying. This is one of the first steps in learning to fly.

In another building is the field manager's office. Here the signals are set that start the airplanes off on their flights. Here also weather reports are posted, and bulletin boards give the news from many other airports. On the roof is a loud-speaker through which announcements that can be heard all over the field are made.

The big terminal building reminds us of a railroad station, for it has a waiting room, a ticket office, a restaurant, baggage rooms, telephone booths, telegraph and radio, and information desks.

Before any pilot starts on a flight, he looks on a big map on which his route is shown. The kind of weather he may expect along the way is marked in chalk, and so is the direction and force of the wind. The map shows places where it is foggy. The marks are changed every little while, since new reports come in almost every hour. Thus the pilot can plan to keep away from the places where he is likely to run into bad weather.

Some fields have maps that work by electricity.

Tiny lights, showing white, green, and red, dot the routes leading from the airport. White means good weather for flying. Green shows weather that is not so good. Red is a warning of storms, heavy fogs, or gales of wind, and means that the pilot must not try to fly over that part of his route. Two lights of different colors show that the weather at that spot is expected to change. Connected with this map are electric bells which tinkle to attract the pilot's attention. Sometimes one bell keeps ringing for a long time, which is a warning of sudden strong winds or heavy thunderstorms. This electric map keeps at work all the time, and pilots can always tell just by looking at it where it is safe to fly and where they must go around some dangerous place.

When we circle above the field in our airplane, we shall see on the roof of one of the buildings in very large letters the name of the airport. We shall see also one arrow pointing north, and another pointing in the direction of the next city on the air-mail or passenger route, with the distance in miles marked beside it. Our pilot tells us that many cities and towns along the route between airports are printing signs like these on the roof of some big building. We can easily understand how helpful this must be to fliers, for when they are high above the ground there are of course no signboards to read, such as automobilists find every few miles along the way.

Radio is very important in guiding airplanes. Messages can be sent back and forth between airports and machines in flight, and on foggy days and nights an airship can be safely brought into port by

a wonderful radio beacon that makes it unnecessary for the pilot to see the ground at all. He simply tunes in his instrument in a certain way, and the radio waves do the steering for him.

After visiting the most interesting parts of the airport, we pick out the machine in which we wish to fly. We think of many questions to ask our pilot. Here are some of the things we learn in our first ground lesson.

Our machine is the simplest kind, a small monoplane with one pair of wings. The first thing we notice is that its front end, or nose, stands quite a little higher than its rear end, or tail. This is so that the propeller may clear the ground when it revolves. After it goes into the air, our airplane will fly on a level keel. The engine and propeller are at the very tip of the nose. The front end of the airplane rests on wheels, and the tail rests on skids that look something like the runners of a sled.

The body of the airplane is called the fuselage. In it is the cockpit with seats for the pilot and the passengers, the tanks of gasoline, and the levers that control the wings, the rudder, and the elevator. At the very front of the fuselage, just back of the engine, is the instrument board. This has so many dials on it that we wonder how anyone can understand it all.

The names of the most important instruments are the tachometer, the speed indicator, the altimeter, the inclinometer, the bank-and-turn indicators, and the compass. This is what they do. The tachometer gives the number of revolutions the

propeller makes in a minute. The speed indicator tells, as you would guess, how fast the airplane is flying. The altimeter shows the airplane's distance above the ground. The inclinometer tells whether or not the wings, the nose, and the tail are level, and the bank-and-turn indicators show how steeply the wings slope up and down when the airplane is changing its direction. The compass, of course, tells whether the airplane is going north, south, east, or west.

There is also a clock, for the pilot must always know what time it is. There is a gas gauge, for he must always know how much gasoline he has in the tanks. The pilot tells us that in the air it is sometimes hard to tell whether the machine is going up or down, so the instrument board has a dial that shows this and also how fast it is climbing or diving.

Now, how does a pilot control his airplane? In his left hand he holds the throttle which makes the engine run faster or slower. In his right he holds the lever known as the joy stick which works the wings and the other parts of the airplane that keep it in the air. Under his feet is the rudder bar with which he does the steering. When he pushes forward with his right foot, the airplane turns to the right, and a push with his left foot turns it to the left.

Before we take our seats in the cockpit, the pilot tells us to look closely at the wings or planes of our machine. Toward the end of each he points out a small movable flap along the edge. This is an

aileron. Ailerons, he says, help in balancing an airplane. If you ride a bicycle, you know that when you go around a corner you must lean toward the inside. An airplane, when making a turn, tilts, or banks, as it is called, in the same way. The ailerons keep it from toppling over sideways. The pilot lowers the aileron toward the inside of the turn and raises the one toward the outside. This brings the machine back to its balance. The ailerons are worked by the joy stick, which the pilot pushes to the left to raise the right wing and to the right to raise the left one.

At the tail of the airplane is the vertical rudder, which works just like the rudder of a boat and turns the machine's nose either to the right or left. Here also is another hinged flap, about the size of the rudder, but horizontal instead of up and down. This is the elevator and is used when the pilot wishes to raise or lower the machine in the air. When the elevator is slanted up, up goes the nose and the machine climbs. When it is slanted down, the nose drops and the machine dives. The elevator, too, is worked by the joy stick. If you wish to go higher, you pull it toward you, and if you wish to go lower, you push it away.

The pilot now hands us our parachutes and shows us how to fasten them on. He tells us that there is hardly a chance that we shall need to use them, but since we are learning so much about flying, we ought to know how to jump from a plane safely if we ever have to.

The name parachute comes from two French

words which mean "to prevent a fall." One of the first balloonists had one with which he intended to jump from high in the air. When the trial came, he changed his mind. He put a little dog into a basket and let the parachute carry him back to earth. It worked perfectly, and the dog landed on the ground very gently.

A parachute, when open, looks like an enormous umbrella without any handle. It is made of light and strong silk, and folds up into a surprisingly small package. We find that ours make very comfortable seats.

When a man has to jump from a burning airplane, or one that is about to crash, he leaps out over the side of the cockpit and lets himself fall for about three seconds. That is to make sure that he is far enough below the plane to let the parachute open without catching on the wings or tail. One way to tell when the three seconds are up is to count "one thousand and one, one thousand and two, one thousand and three." Try it and see. You probably will never have to count three seconds while falling through the air, but you might want to in playing some game.

After three seconds the man with the parachute pulls a cord. This rips open the package and allows the parachute to be caught by the wind. The man's swift fall stops instantly, and he drifts slowly down to earth. He can guide his parachute by pulling different cords, and he should be able to land in an open field instead of in a treetop. Finally he touches the ground, not much harder than he would if he

jumped from a ten-foot fence. A man has dropped from an airplane four and a half miles in the air. His parachute brought him down in about thirty minutes, and he landed without any harm.

To show us how safe flying is today, our pilot tells us about the great fleet of more than six hundred and fifty airplanes belonging to the United States Army and the flight they made in 1931. They all started from the flying field at Dayton, Ohio, and flew first to Chicago, then to New York, then to Boston, back again to New York, and finally to Washington, D.C. At each city these planes did all sorts of difficult flying as practice for the pilots.

With so many planes in the air at once, flying at high speed, turning and twisting, diving and climbing, you would have thought that there would be many accidents. Sometimes two planes would be so close to each other that their wings nearly touched, but there were no collisions, and only two mishaps that were at all serious. That is a wonderful record, for the total number of miles flown by the six hundred and fifty planes was more than two million. We get a very good idea of how few and far apart the accidents were when we figure out that if these planes had all flown across the country from ocean to ocean, only two of them would have met with trouble.

Our pilot seems to have at the tip of his tongue most of the records made by aviators. When we ask him the highest speed ever made by an airplane, he tells us that in 1933 an Italian flier traveled at the rate of 427 miles an hour. That is about four

times as fast as the airplanes that we see day by day usually fly, and it is nearly six times as fast as an express train moves.

Our pilot tells us also about Professor Piccard in Europe who wanted to find out how high above the earth he could go. He and a companion used a balloon, not an airplane. They themselves rode in an airtight metal ball hung below the balloon. They went almost ten miles into the part of the air that is called the stratosphere. When everyone had given them up for lost, they dropped out of the clouds and landed safely on a glacier in Austria. They had been away from the earth about eighteen hours. Here are some of the surprising things these men saw when they were at the highest point in their flight. The sky was a very dark blue, and even in the bright sunlight, the moon and stars could be seen. The earth, instead of looking like a round ball, seemed like a saucer with a turned-up edge. Mountains, lakes, and forests could be made out, but other parts of the landscape were blurred. There was no wind and there were no clouds, but the weather was intensely cold, more than sixty degrees below zero. How would you like to visit a world so different from the one we know?

In November, 1935, two American army officers, Captain Stevens and Captain Anderson, set a new altitude record of 72,395 feet. This is slightly less than 14 miles. Professor Piccard is now planning to try to beat this record.

We ask what is the longest time that any flier has stayed in the air, and our pilot tells us this story.

Earlier in the year 1935, two brothers named Key, also Americans, went up in an airplane on an endurance flight. They planned to cruise around in the air as long as they could, and arranged to have other planes bring them supplies of gasoline, oil, and food as often as they needed them. How long do you suppose it was before these men thought they had better bring their plane back to earth? It was more than 653 hours. How many days does that amount to? Just think how well-made an airplane's engines must be to run all that time without stopping.

"Now," says our pilot, "I think it is time for us to take the air ourselves, but we shall not try to make any records." We put on the goggles and helmets which he hands us, for in the open cockpit we shall need to be protected from the strong wind the flying plane makes. The pilot fastens the safety belts that hold us in our seats, for no one wishes to be spilled out when the plane turns or banks in the air. "All set?" asks our pilot. "All set!" we reply. So off we go, and for fifteen minutes we have the same thrills that the boy had about whom we read on another page in this book.

Then, when, all too soon, we come back to the landing field, we go home feeling much as did the first men who ever flew. We are more interested than ever to find out how they learned to fly, what the first airplanes were like, and to read the stories about famous flights and the aviators who made them.

WHAT TO READ

Aircraft Book for Boys. Dorothy Averill.

Chapters 9, A Visit to a Modern Airport; 10, Let's Take the Air.

Airways. Engleman and Salmon.

Stories about the history of aircraft with some scientific explanation. There are suggestions of "Things to Do."

Alphabet of Aviation. Paul Jones.

"Ballooning in the Stratosphere." Auguste Piccard. *National Geographic Magazine*, vol. LXIII, no. 3, March, 1933.

Boys' Book of Airmen. Irving Crump.

Chapters III, Lindbergh and the Caterpillar Club; XX, My First Parachute Jump.

Man's Wings. Richardson and McCormick.

Some of the chapters are: Why an Airplane Flies; Learning to Fly; Landings; The Take-Off; and Turns.

Playing Airplane. J. F. McNamara.

"Perhaps," says the author, "this book will help you to be a good aviator when you grow up." Some of the chapters are: What Holds Up an Airplane; How to Operate Your Plane; Looping the Loop; On the Way Down; Landing; and Flying from New York to Paris.

HOW MEN LEARNED TO FLY

Tales from many lands — How men tried to make wings — The beginnings of real flight — Men are still experimenting — What the first airplanes were like — The largest airplanes ever built.

MANY stories that have come down to us from olden times tell how their heroes flew through the air. If you have read Josephine Preston Peabody's *Old Greek Folk Stories*, or Hawthorne's *Wonder-Book* and *Tanglewood Tales*, you already know some of them. There was Mercury, you remember, the messenger of the gods who had a winged hat and winged shoes that gave him the power of flight. There was the winged horse, Pegasus, upon whose back the hero, Bellerophon, was carried high above the earth. Perhaps also you have read in the *Arabian Nights* about the magic carpet and the wonderful voyages it made.

From China comes the story of a man who put on magic shoes that lifted him beyond the clouds. Fairy stories from other foreign lands tell about giants and the thousand-league boots that carried them swiftly over mountains and cities. A story from India tells about an airship made in the shape of a huge bird, painted in such a way that it could not be told from a real bird. It had springs to make it go up or down and to change its speed. Another legend from Persia says that a king of that country planned to sail through the sky in a carriage drawn by eagles. To tempt the eagles to keep flying, bits of food were hung in front of them on wires. This scheme failed to work and probably no one was surprised.

Then there are other stories that tell how men tried to make wings for themselves, which they could fasten to their bodies like the wings of a bird. The most famous one is the Greek myth about how Dædalus and his son Icarus tried to escape from an island. They made wings which they fastened to their shoulders with wax. Icarus flew too high and went so near the sun that the wax melted and the poor boy fell into the sea.

An American poet, J. T. Trowbridge, has some very amusing verses about a Yankee lad who said, "Birds can fly, and why can't I?" This boy rigged up a springboard and some wings like a monstrous bat. But when he jumped out of a second-story window in the shed, instead of flying he fell heels over head to the ground. Look up this poem, "Darius Green and his Flying Machine," and read all about it for yourself.

When men made the first experiments with wings, they did not have the right idea. They did not know that, to hold a man in the air, wings twenty feet long would be needed. No man, of course, would be strong enough to flap such big wings. Some inventors believed that the wings must be made of feathers. Because birds had feathers, these men believed that this was the chief reason why these little creatures could fly. So they tried to build wings like those of birds.

Finally, someone learned something important by watching a stork teaching its young ones to fly. You yourself can notice some of the things that this man found out if you watch closely a sea gull, a crow, a

pigeon, or some other common bird. You will see that their wings are rounded on top and bottom, instead of being perfectly flat. A bird moves its wings with a flapping motion when it rises into the air and when it is going somewhere. But now and then you see one sailing along, perhaps getting ready to alight, with its wings spread but not flapping them. It slants them up or down to catch the air in a way that will carry the bird higher or lower, or that will allow it to circle to one side or the other.

This curved shape of a bird's wings is one of the secrets of its flight. After men began to curve the wings of their flying machines, they slowly learned what else they must do to be able to fly. We use the word "cambered" to describe the curved shape of the wings of an airplane. Take a piece of blotting paper about six inches long and two and a half inches wide. Hold it with your thumbs on one of the long edges and your forefingers on the other. Press these two edges very gently together, and you will make your blotting paper curve in somewhat the way a cambered wing does.

Now there are two forces that keep an airplane from falling. One is its engine which keeps the propeller revolving so that the airplane keeps moving ahead. The other is the pressure of the air upon its planes or wings. Unless the machine is drawn forward by the propeller, it will soon drop to the earth. But while it moves ahead, and so causes a current of air to press upon its planes, it will not fall.

It may surprise you to learn that it is the air pressure upon the upper surface of the planes that has most to do with keeping the airplane up. This is because the cambered shape forces the air past the planes in such a way that the machine is pulled up by suction from above. This is important to remember. Many people do not know that it is true. They think that it is the upward pressure of air against the lower surface of the planes that supports the machine. This helps, of course, but not nearly so much as the suction from above.

If you can find in the public library a book named *The World in the Air*, by Francis Trevelyan Miller, you will spend many interesting hours in looking at the pictures, and in reading some of the stories printed with them. This book goes back to the very beginning of man's trying to fly, and its two volumes contain over twelve hundred pictures.

You will learn that men of many nations studied the problem, some of them as long as three thousand years ago. The ancient Greeks tried to find out how a man could balance himself in the air, and so did the Chinese and the people who lived in what is now England.

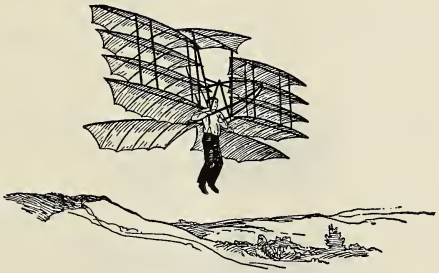
An Italian, Leonardo da Vinci, in the days of Columbus, suggested ideas that were worked out hundreds of years later. This man was one of the world's most wonderful inventors, and you will find his name in many books of history and science. You will often see copies, also, of the beautiful pictures that he painted. After his time other Italians and Frenchmen, Englishmen and Germans tried many

different schemes. Some of these men worked with balloons, and others tried different kinds of machines with wings.

In those days there were no engines that could be used in flying machines, so all the experiments were made with the sort of airplane that nowadays is called a glider. Men had given up the idea of strapping big wings to their arms and legs and then jumping from some high place. They had learned from many falls that they could not keep themselves up by beating the air with such wings. Instead, they made cambered planes, shaped as nearly as possible like the wings of birds. They discovered how to launch themselves into the air by running down a hill with these planes fastened to their waists. Then, when the wind lifted them off the ground, they found out how to balance themselves in the air while they glided a short distance. The farther they glided, the slower they went, and they always landed on ground lower than the hill on which they started. Finally one man glided about nine hundred yards. In our day men are again studying gliders. A German is said to have made a flight of one hundred and sixty-five miles.

The earliest gliders that would carry a man were very strange-looking. One had six planes, one above another. Several had bodies shaped like a cigar, or a fish, with two or three pairs of wings along the sides. Some were shaped like a bird with a tail as well as wings. One had a pointed head like a rocket and five pairs of wings. Another, which was not exactly a glider, had a big umbrella with a number

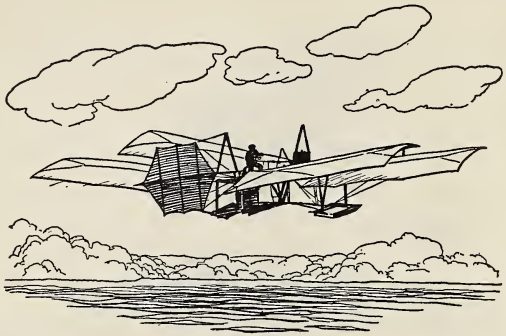
of fans underneath. This machine was supposed to be driven through the air by rowing with the fans.



An American built a glider like this in 1896. Once he traveled 360 feet through the air. This was thought a great feat.

Finally, about forty years ago, an American proved that his ideas were better than any that had been tried before. His name was Samuel P. Langley. He made a little model with planes like those in the best full-sized gliders, and put a tiny steam engine into it. It flew so well that Langley made a larger machine, big enough to carry a man. This was so heavy that the only way he could get it into the air was to slide it down a runway built on the roof of a house boat on a river. Something went wrong with the launching, and the machine was smashed. A few years afterward when a light-weight gasoline engine had been invented, another aviator took Langley's old machine, put one of the new engines into it, and proved that it would really fly. It is a shame that Langley died before this

could be done. If he had had the right kind of engine, he could have flown his machine himself.



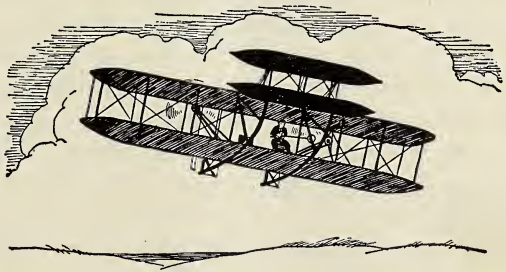
Langley's airplane is made to fly.

In the meantime two other Americans, the Wright brothers, had been working hard, first with gliders and afterward with a machine that had an engine. At last, in 1903, in a biplane, or machine with two planes, one above the other, Wilbur Wright stayed in the air 59 seconds and traveled 852 feet. That is a little less than three times the length of a football field.

When we compare this with the records made during the last few years, it seems a very little thing. The important fact about it is that it was the real beginning of true flying. It was the first time in the history of the world that a machine driven by power and carrying a man had lifted itself from level ground, had sailed along without losing speed, and had finally landed without an accident.

When the Wright brothers made their first flight,

a newspaper man heard of it and offered to send a story about it to some newspapers for which he was reporting important news. One of the editors answered, "We don't want any such cock-and-bull yarn as that." A magazine editor did buy an account written by one of the Wrights, and his employer was very angry. "Any man," he said, "who says he can fly is crazy."



The first Wright biplane driven by an engine. The earliest airplanes were built of light wood and had linen wings.

But the Wright brothers kept on with their work. They relied on themselves and asked help from nobody. They had only a little money. Once when they needed a stove, they made one from old tin cans instead of paying seven dollars for one. When they wanted a new engine for their airplane, they could not find anyone who would trust them for it. So they built it themselves.

Before long they were invited by the French Government to go to France to show what they could do in the way of flying. The people there were very enthusiastic. When they came home, the Wrights

found themselves welcomed as the national heroes they were and always will be.

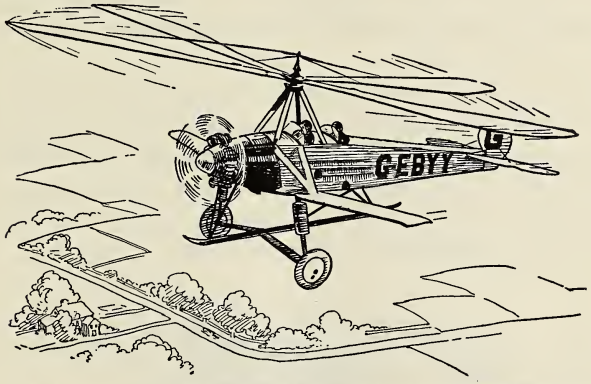
In 1932, near the place where these young men made their first short flight, a tall granite memorial was built. This is at Kitty Hawk, North Carolina. From the top a beacon will always shine throughout the night to guide not only men flying through the air, but sailors on ships at sea.

Kitty Hawk, you will be interested to know, is in a part of our country famous for other events. It is within fifty miles of the spot where the first English settlers, sent out by Sir Walter Raleigh, landed more than three hundred years ago. It is about the same distance from the town where the first lawmakers of Virginia met seventy-five years after that.

A few men are still trying to work out plans for airplanes that will fly by flapping their wings. No one can tell whether they will ever succeed or not. If you come across the word ornithopter in a newspaper story about airplanes, you will know that it means this sort of machine.

A word that you will be more likely to find is helicopter, and another is autogiro. Each of these means an airplane that can lift itself straight up into the air without taking any run along the ground to get started. It can also come straight down. Perhaps you have seen machines of this sort in the air, for they are becoming quite common. If you see a machine with what looks like a huge electric fan on top, it is an autogiro. Such airplanes have also the usual propeller in front to draw them for-

ward. The big fan on top simply lifts them or lowers them.



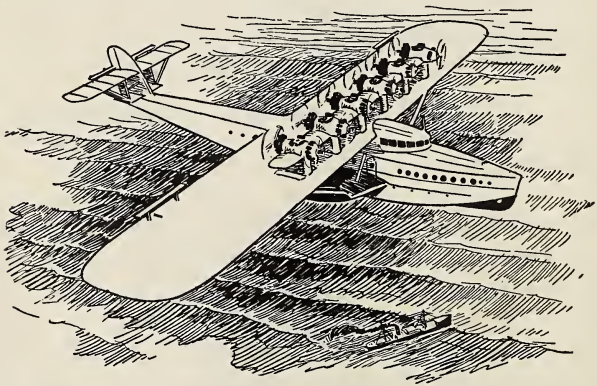
An autogiro. The wind makes the fan on top revolve while the airplane flies, but the engine turns the fan when the airplane goes up or comes down.

The first airplanes ever made were very small indeed compared with the largest ones in the world today. From the tip of one wing to the tip of the other, they measured thirty feet. They could lift into the air only about six hundred pounds, and this weight included both the machine and the one or two men who could crowd aboard. They had only one engine, and when they flew they seemed to flutter feebly along.

Your father will probably remember that only a few years ago there were rules forbidding airplanes to fly over cities. People were afraid that the machines would come tumbling down on their heads, and they wanted them to keep away from

crowded places. How strange it would seem to us if the big passenger planes that go humming through the sky like huge dragonflies circled around every city and town along their routes instead of traveling in a straight line!

If you had been in New York one September day in 1931, you might have seen the largest airplane then built swooping down from the sky and alighting like a sea gull upon the water of the harbor. This was the Do X, a German flying boat just finishing a flight from Europe by way of Brazil.



The DO X. You see the twelve engines on the upper side of the wings. Below the left hand wing a corner of one of the pontoons shows.

Let us see how much larger she is than the early airplanes. The wings of the Do X are 157 feet from tip to tip, as long as a line of 10 automobiles, parked closely together, end to end. On top of the wings, so high that no spray can dash over them when the

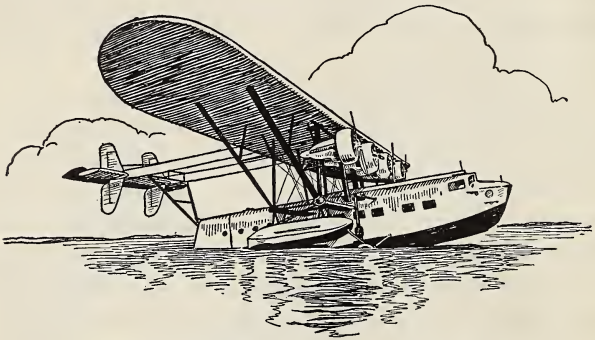
Do X takes off from the water, are 12 engines arranged in pairs. The airplane itself weighs about 61,000 pounds — more than 30 tons, or as much as a railroad flat car. Besides this weight she can lift a load of 22 tons more.

Usually the Do X carries a crew of 40 men. She has cabins for 72 passengers. Once, on a trial trip, she carried 169 people into the air. On the trip that ended in New York, she brought only her crew all the way from Europe, but picked up about 30 passengers at different ports in South America and the United States.

We call the Do X a flying boat because she is built to float upon the water when she is not flying. She has pontoons like an amphibian, but no wheels or skids, so she cannot make a landing on solid ground. When she is on the water, most of her weight is floated by her hull which is shaped like the underwater part of a sailing vessel. From bow to stern this hull is 131 feet long. It has three decks, one above the other. One of them has a room 60 feet long, which is used either as a lounge, a dining room, or for dancing. This room has comfortable chairs and soft carpets, and looks much like a huge Pullman car.

It seems strange that so wonderful an airplane was given such an uninteresting name as Do X. She was planned by a man named Dornier, and this may explain her first two letters. Perhaps the X was added because she was an experiment. It has not yet been proved that so huge an airplane will be suitable for use as a liner, for carrying passengers and freight

over long distances. She was planned to make short journeys over water, perhaps between different ports in Europe or between islands in the West Indies. Her flight from Europe showed, however, that she can make long trips. She started from Portugal and flew first to the Canary Islands. Then she touched the coast of Africa, and after that the Cape Verde Islands. From there she hopped all the way to Rio de Janeiro.



The American Clipper. She has just landed in the water. You can see the top of one of the wheels on which she will run closer to the shore.

The largest airplane thus far built in our own country is an amphibian. She is named the American Clipper in honor of the old-time sailing ships that did so much about eighty years ago to make our flag known on all the oceans of the world. She is considerably smaller than the Do X, for her wings measure 114 feet and her hull is 76 feet long. She has four engines and needs a crew of only five men.

She can carry 45 passengers and a ton of mail and freight besides.

Passengers on airplanes like the American Clipper have almost as many things to make them comfortable as those who ride on trains and steamships. They have good-sized cabins, running water, electric heat, and even a kitchen range and a refrigerator that are run by electricity.

The American Clipper is one of the largest amphibians in the world, but her builder says that he has now learned how to make one twice as big, if a ship of that size is ever wanted. He is a Russian named Sikorsky, who came to the United States when he was thirty years old. He began building airplanes when he was only twenty-one, and he has now built forty different ones. The people of all nations have always been much interested in his ideas, so when the American Clipper made her first flight, many foreigners were invited to go. There were people from each of the twenty-one republics in the Americas, and also from Great Britain, France, Germany, Italy, Belgium, Holland, Poland, Finland, and even Siam.

The American Clipper is now flying as a regular liner on the routes of the Pan-American Airways. She goes from ports in the United States to places in Central and South America and the West Indies. A sister ship, named Caribbean Clipper, recently joined her, for air travel between the United States and our neighbors to the south is steadily becoming more popular.

There are also four other great airplanes, named the Brazilian Clipper, the Caribbean Clipper, the Porto

Rican Clipper, and the Trinidad Clipper, which make regular trips to the eastern coast of South America and the West Indies. They also are Sikorsky amphibians. They carry mail and passengers. These airplanes weigh 19 tons each and have a speed of 190 miles an hour.

More wonderful still are the three new amphibians each weighing 25 tons that fly regularly across the Pacific from California to the Philippine Islands. They were built by an American named Glenn Martin. Their names are the China Clipper, the Hawaiian Clipper, and the Philippine Clipper.

They make stops at Honolulu, Midway Island, Wake Island, and Guam. The whole trip, including stops, takes about five days. Steamships take two weeks or more.

WHAT TO READ

Boys' Life of the Wright Brothers. Mitchell Charnley.

Historic Airships. R. S. Holland.

Begins with stories about the first voyages in the air, and ends with the great adventures of the year of 1927.

"The Magic of Wings." Fitzhugh Green. *Home Geographic Monthly*, vol. I, no. 1, Jan., 1931.

"Man's Progress in Conquering the Air." J. R. Hildebrand. *National Geographic Magazine*, vol. XLVI, no. 1, July, 1924.

The Mastery of the Air. W. J. Claxton.

There are chapters on The Hydroplane and Airboat and Ocean Seadromes.

"On the Wings of the Wind." Howard Siepen. Flights in motorless airplanes. *National Geographic Magazine*, vol. LV, no. 6, June, 1929.

Wonder Flights of Long Ago. Barry and Hanna.

Eleven of the most familiar myths and legends about flying. Suggestions for dramatizing the stories, making maps of famous flights, etc.

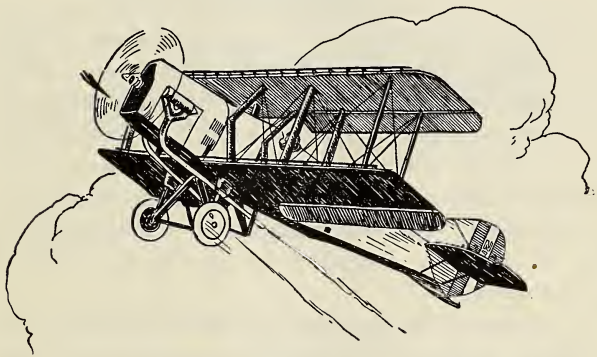
The World in the Air. F. T. Miller.

The World We Live In and How It Came to Be. Gertrude Hartman. Chapter XXI, Conquering the Air.

SOME WONDER FLIGHTS

The first flight over water — First across the Atlantic — First around the world — Flights across the United States — Lindbergh's greatest flight — Other ocean flights in 1927 — The Bremen flies from Germany — The Southern Cross explores the Pacific — Some French fliers return Lindbergh's call — The "flying rainbow" — Around the world in eight days — The first flight from Japan to America — The longest non-stop flight by Americans — The "flying gas tank" — How do such flights help the world?

NOW let us read about some of the famous air voyages made since the Wright brothers taught the world how to fly.



An English biplane, much like the one used on the first flight across the Atlantic.

In 1909, a Frenchman named Blériot crossed the narrowest part of the English Channel in a monoplane which he himself had planned. This flight was twenty miles in length and it was made in thirty-seven minutes. It was the first time that anyone

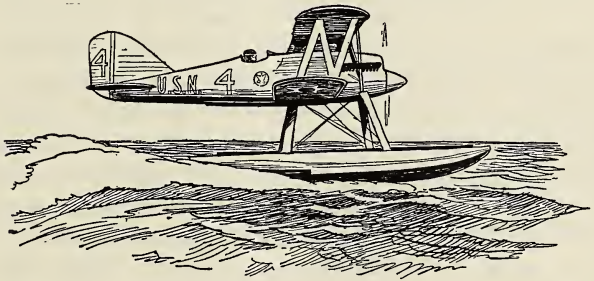
had dared to fly across a wide stretch of water. For ten minutes of the time, Blériot saw nothing but sea and sky, since he had lost sight of the ship that he was trying to follow. During those minutes he feared that he might lose his way, but he soon landed safely and was hailed as a new hero of the air.

In 1919, two Englishmen, Alcock and Brown, made the first non-stop flight across the Atlantic from Newfoundland to Ireland. They used a biplane, because that sort of airplane is stronger than one with only a single pair of wings. It is safer on a long flight. They took about sixteen hours, flying at about 118 miles an hour. Their plane was smashed in making the landing, but the men were not hurt. That same year a small seaplane or flying boat, belonging to the United States Navy, crossed the Atlantic from west to east, but stopped at the Azores on the way. This was the NC 4. Like most naval aircraft she was a biplane. Naval vessels were stationed short distances apart to help the fliers in case of need. Two other seaplanes that started with the NC 4 were forced down by fog and had to return home.

A seaplane, as perhaps you have guessed, is an airplane whose landing gear has pontoons or small boat-shaped floats so that the machine can take off from the water and also alight on it. An ordinary airplane has wheels instead of floats, because its flights begin and end on land. An amphibian, you remember, has both floats and wheels.

In 1924, a squadron of biplanes belonging to the United States Army started to fly around the world.

Four machines took off, but only two were able to finish. The route was 26,345 miles in length, divided into eight stages, and it took the two planes 175 days to cover it. The actual time spent in flying was 15 days and 3 hours. The rest of the time was used in making good-will visits in cities and towns along the route. Now and then it was necessary to change pontoons to wheel landing gear and to overhaul the engines.



A seaplane, or flying boat. It has a metal fuselage and metal pontoons. The wings are linen, stretched on a metal frame.

You can follow the route in a general way on the map if you look up the following places. Seattle, in Washington, was the starting point. Then the course skirted the coasts of Canada, Alaska, Kamchatka, and Japan. In Asia it crossed China, French Indo-China, Siam, Burma, India, Persia, Mesopotamia, Syria, and Turkey. In Europe it crossed Rumania, Hungary, Austria, France, and England. The homeward route touched the Orkney Islands,

Iceland, Greenland, Newfoundland, Labrador, and Nova Scotia. American soil was reached at Boston, and then the fliers crossed the country to Seattle, stopping at several places along the way. The admiral who welcomed them home complimented them on overcoming many great difficulties, and said, "Other men will of course fly around the world, but never again will anyone fly around it for the first time."

The first flight across the United States from New York to San Francisco was made by Lieutenant Maughan of our Army, in 1924. The route he followed was 2540 miles long. His time was 17 hours, 52 minutes. A record for a flight in the opposite direction was made by Colonel and Mrs. Lindbergh, when in 1930 they flew from Los Angeles to New York in 14 hours, 45 minutes. Three years later, another famous aviator, Colonel Turner, covered the same route in 10 hours, 5½ minutes. Some fliers think that before long the record across the continent will be only about eight hours.

Colonel Turner has flown from New York to Los Angeles in 11½ hours. Compare the time a flying machine now takes for this journey with the time a railroad train takes. Compare it also with the time needed by the Conestoga wagons and the stage-coaches, about which you will read in the chapter on "Old-Time American Conveyances."

The year 1927 will always be a famous one in the history of flying. It was then that Charles A. Lindbergh made himself known all over the world by doing something that no one had ever tried to do before.

For some time this young man had been one of the most skillful pilots in the United States Air-Mail Service. He had been thinking about a prize that was offered for the first successful flight from New York to Paris, and he now made up his mind to win it.

Several other fliers were getting ready to try for it too, but Lindbergh had a plan more daring than any of them. Usually on long flights two men went together, because that is of course a safer way. Lindbergh, however, said, "No, I'll carry extra gasoline instead of another man."

Lindbergh's monoplane was named The Spirit of St. Louis because some men of that city were paying the costs of the flight. They knew that Lindbergh was a wonderful flier, and that everything he did he planned carefully. They felt sure that he would succeed. The picture on the title-page of this book shows this famous airplane.

On May 20, Lindbergh took off alone from Roosevelt Field, New York. For 33½ hours he flew steadily, sometimes high in the air near the clouds and sometimes so low that the spray from the ocean dashed into his machine. Once he leaned out and called to some men in a fishing boat, "How far to Ireland?" but they only waved their hands and did not answer. Probably they could not hear him.

The Spirit of St. Louis passed over Ireland almost exactly where Lindbergh planned. Forward it swept toward Paris until the lights of the landing field appeared below. Lindbergh brought his airplane to the ground and stopped the engine. It had brought

him 3605 miles, working perfectly all the way. To the people who rushed to greet him the young man said simply, "I am Charles Lindbergh, from New York" — as if flying the Atlantic alone was the easiest task in the world. A safe arrival, or as the fliers call it "a happy landing," was the only thing to expect!

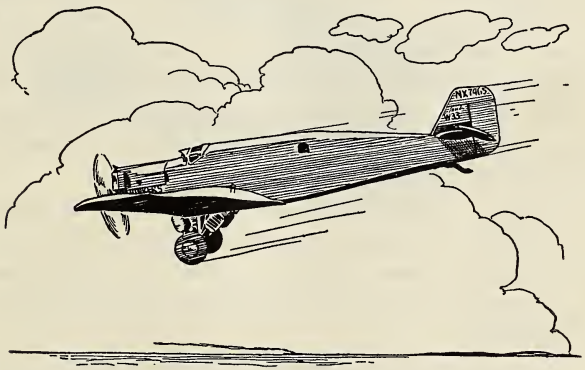
When you go to Washington, you can see at the Smithsonian Institution the airplane in which Lindbergh made this daring journey. In the same building you will see also other airplanes, some earlier than his and some later. It will be interesting to notice the differences between them.

Sometime you should read a poem by Nathalia Crane named "Wings of Lead." She wrote this when she was a little girl of fourteen years. It won her a prize for the best poem about Lindbergh and his flight, although four thousand other people sent poems to the judges.

Other American fliers made names for themselves in 1927. In June, Chamberlain and Levine flew a monoplane named Columbia from New York to a small town in Germany, about 118 miles from Berlin. The distance was 3911 miles and set a new record for a flight without stops. The fliers had aimed at Berlin, and probably would have reached there if their gasoline had not given out. Their time in the air was 42 hours, 45 minutes.

At about the same time, Lieutenants Maitland and Hegenberger of our army flew a monoplane from Oakland, California, to the Hawaiian Islands. The distance was 2400 miles and the time was 25 hours, 50 minutes.

Look on a map and see what a small spot the Hawaiian Islands make in the wide expanse of the Pacific Ocean. Hitting this mark was like hitting the bull's-eye in a target. If the two officers had not kept their aim true by using their instruments in exactly the right way, they might have missed the point for which they were aiming. This would have caused them a great deal of trouble, for the nearest land beyond the Hawaiian Islands is many miles away.



This is a low wing monoplane like the Bremen

The first crossing of the North Atlantic westward — that is, from the mainland of Europe to America — was made by the monoplane Bremen in 1928. Two Germans, Koehl and von Huenefeld, started from Berlin and flew to Dublin. There they took aboard an Irish army officer, Fitzmaurice, and the three men set out for America.

After leaving the coast of Ireland, the Bremen was not seen until she landed thirty-four hours later on a little island near Newfoundland. The fliers did not see a single ship while crossing nearly two thousand miles of ocean. The latter part of the flight was made through heavy fog, and some of the time they flew only fifty feet above the water.

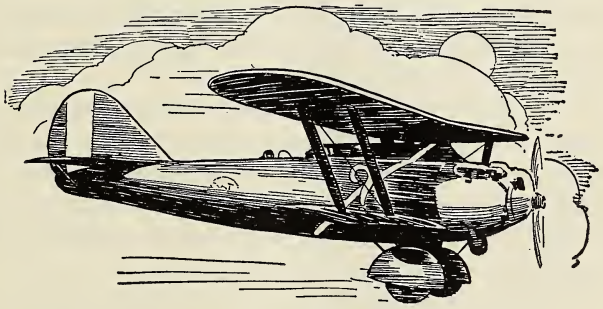
Their first sign of land was a lighthouse, showing dimly through the fog. They were short of gasoline, so they came down. The Bremen broke one of her landing wheels when it struck soft ice, and this threw the plane into a nose dive which broke other parts. But the fliers themselves were rescued and the Bremen was repaired. She was brought to the United States, and you can now see her at Washington, in the same museum where Colonel Lindbergh's Spirit of St. Louis is kept.

In 1928, too, another monoplane with an international crew made a remarkable flight. This was the Southern Cross, and she carried an Englishman, an Australian, and two Americans from California to Australia.

There were three hops in this flight. The first was from Oakland, California, to the Hawaiian Islands. The second was to the Fiji Islands, 3138 miles entirely over water, which was something unheard of. How astonished the natives of those far-away islands must have been when the huge birdlike flying machine swooped down from the sky! The third hop of the Southern Cross was to Brisbane, Australia, where she arrived safely after flying, in all, 7400 miles. On her voyage from America she

spent 83 hours, 15 minutes in the air. Much of the time she had to fight head winds and rain. Sometimes currents in the air made it bumpy, and the machine tossed about like a rowboat among high waves.

A dozen or more interesting flights were made in 1930. Here are the stories of three of them.



The Question Mark.

In September, two Frenchmen, Coste and Bellonte, returned Lindbergh's call by making the first nonstop flight from Paris to New York. Their monoplane was named the Question Mark. They flew 4100 miles in 37 hours and 18 minutes. You will notice that this distance is longer than Colonel Lindbergh's flight. The reason is that storms forced the Question Mark to make several detours. An east-to-west flight is always harder than one from west to east because most of the time fliers face a head wind. Perhaps you have heard that ocean steamships coming from England to the United

States take longer than they do in going the other way. This is due to the same reason.

About a week before Christmas, a squadron of twelve Italian seaplanes left Italy on a flight to South America. A great many Italians have gone to that continent to make their homes, and there is much friendship between many South American countries and Italy. The flight was intended to show that a trade route through the air might be set up, over which groups of seaplanes flying together could carry large quantities of goods.

The route of these Italian seaplanes ran across the northern part of the Mediterranean as far as the tip of Spain. There it crossed to the shore of Africa, which it followed as far as the point where the Atlantic between Africa and South America is narrowest.

Two of the seaplanes were forced down near the take-off. Others took their places, but they also were forced down part way across the ocean, where they were rescued by Italian navy ships stationed along the route. The other ten seaplanes completed the hop successfully, flying 1875 miles in 17 hours, 15 minutes.

This squadron was known as the "flying rainbow," for some of the seaplanes were green, some white, some red, and some black. Can you tell the reasons for these colors?

The landing was made at Natal, in Brazil, where a great crowd of cheering people was waiting in the rain. This flight was the first in which a number of airplanes had flown close together for a long distance.

In 1933, Italian fliers visited the Century of Progress Fair in Chicago. General Balbo was again the leader. This was the greatest flight by a squadron of seaplanes yet made.

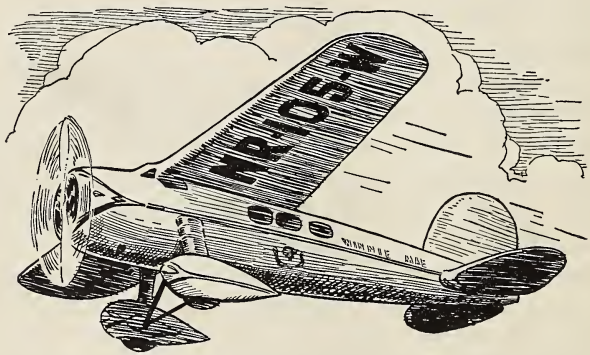
Twenty-five planes left Rome in June. Two were wrecked in accidents, but the others returned safe after a 12,000 mile round trip. The longest and most dangerous hop was from Ireland to Labrador. There was fog much of the way. On the journey home, the planes flew from Newfoundland to the Azores without stopping. Then they flew to Lisbon, Portugal, and then to Rome. When they reached home, there was a celebration like the old Roman triumphs.

Have you heard the story of the monoplane named Winnie Mae, in honor of a young lady? This is the airplane in which two Americans, Post and Gatty, traveled around the world faster than anyone had done before. An oil man of Oklahoma City paid their expenses, so his daughter's name was given to their machine.

Post and Gatty took off from Roosevelt Field June 24, 1931. They landed there again July 1, having flown around the world in 8 days, 15 hours, 51 minutes. They were in the air four days of this time, and they traveled almost 15,500 miles. They picked out a route which avoided wide stretches of water, and which also followed the shortest possible line around the globe.

Landings were made in Newfoundland, England, Germany, Russia, Alaska, Canada, and at several places in the United States. In the part of Russia

named Siberia and again in Canada, the fliers had to bring their plane down on fields of oozy black mud. The landing wheels sank so deep that for a while the men feared that the Winnie Mae could never pull herself out. It looked as if the flight would be ended there. But finally people came to their help with automobiles and tractors, and the airplane was hauled out on firmer ground. When everything was ready, Post and Gatty took their machine into the air again, and in the end they flew safely back to their starting place.



The Winnie Mae. Notice the differences between this airplane and the Question Mark.

Almost exactly two years later, Post again flew around the world in the Winnie Mae. This time he went alone. He set an even faster record than the one he and Gatty made in 1931. He flew 15,400 miles in less than eight days. When he got back home he said, "I still think I can do it in five days."

Here are the records for journeys around the world from the time the first one was made to the present. It is interesting to compare them.

1519–1522	Magellan's ship, the Vittoria	1083 days
1577–1580	Sir Francis Drake in his ship, the Golden Hind	1052 days
1924	Airplanes of the United States Army	175 days
1925	A traveler by ships, railroads, and airplanes made the journey in a little less than	29 days
1929	The German dirigible, Graf Zeppelin	21 days, 7 hours, 34 seconds
1933	The American airplane, Winnie Mae	7 days, 18 hours, 49 minutes

We wonder when Post's record will be broken, and what the new one will be.

Some years ago a Japanese newspaper offered a large money prize for the first successful non-stop flight from Japan to the United States. This was won in 1931 by two young Americans, Pangborn and Herndon. They had started out from Floyd Bennett Field, Brooklyn, New York, soon after Post and Gatty had returned from their round-the-world flight. They started out to try to beat that record around the world, but they met with delays almost from the first. Finally in Siberia, they had to wait so long for repairs to their plane that they changed their plan and went to Japan to try for the newspaper's prize.

On Saturday, October 3, they took off from a beach near Tokio with a heavy load of gasoline, oil, and food. Three hundred miles out at sea they lightened the load by dropping off their landing wheels. They trusted to luck to get back to earth safely after reaching America. Their flight was the

most dangerous one that had yet been attempted, and all the way across the Pacific they met fog and storms. The wings of their airplane became so coated with ice that they had to fly very close to the surface of the ocean.

At last, after flying 41 hours, 31 minutes, they made a safe but risky landing at Wenatchee in the State of Washington. The airplane bumped down on the underside of her body, tipped over on her nose, settled back, skidded roughly, but finally nosed up and came to a stop. Her propeller was broken, but the daring young Americans had won their prize. For the first time in the history of the world, an airplane had flown from Japan to America, a distance of 4458 miles.

Many of the flights that we have been reading about covered long distances, and there were no stops between the start and the finish. Most of them were undertaken, however, not to see how far an airplane could fly before it had to come back to earth, but to prove that a flight between two distant places was possible. One day in 1931 two Americans decided to try to make a longer non-stop flight than anyone had ever made before. Their names were Boardman and Polando, and they took off in their monoplane named Cape Cod just two days after Pangborn and Herndon left Floyd Bennett Field.

Their airplane could carry 728 gallons of gasoline. Before they started, Boardman and Polando studied their map carefully. They made up their minds that they could fly about five thousand miles on their supply of fuel, and they found that Istanbul,

Turkey, was just about that distance from New York. So they started for that far-away city.

They crossed the Atlantic without once seeing the ocean through the fog. There was fog also over Ireland, England, and France, yet the fliers were able to keep on a fairly straight course. Among the Alps they had rather a hard time because there were clouds above them as well as below, and they feared that they might crash into some mountain peak. They managed to pilot the Cape Cod over some of the mountains and along the valleys between others.

Farther on there were more mountains to cross. It was easier there because the air was clearer and the fliers could see to follow the streams winding in and out among the hills. Finally they came out over level country and headed for Istanbul.

When they landed at an airport near that city, they measured the gasoline they had left, and found less than five gallons. They had flown 5139 miles, which was just about what they had hoped to do. Their journey by air took 49 hours. If we were to take the fastest ship to Europe and the fastest train across that continent, it would take us about five times as long to travel from New York to Istanbul as it took the Cape Cod. This is one more fact that shows how airplanes are changing our idea about the distance to foreign lands and the time it takes to reach them.

Can you find out whether Boardman and Polando's record has been beaten?

In August, 1932, a British officer, Captain Mollison,

made a flight that set up three records for the westward crossing of the Atlantic. He made the first solo flight from Europe, he flew the smallest plane, and he made the best time.

His monoplane was named Heart's Content. It was nicknamed "the flying gas tank" because it carried 170 gallons of gasoline. The route followed by Captain Mollison was 2800 miles long, and his time between Ireland, where he took off, and New Brunswick, where he landed, was 30½ hours.

The flier had planned to land in New York, but he had used nearly all his gasoline and he was very tired. When he saw a large meadow which looked like a good landing place, near St. John, New Brunswick, he decided not to go any farther.

"Flying conditions were good for a while," said Captain Mollison to newspaper reporters. "But as night came on I ran into fog. I tried to climb above it, but my plane was too heavily loaded with gasoline. My engine worked perfectly all the way. More than five hundred miles out at sea I sighted a liner. She gave a blast of her siren in salute. She must have been surprised to see a plane so far from land.

"What I thought most about was getting to America. I wasn't hungry. You don't get hungry flying a plane across the Atlantic alone at night with thunderstorms around you. Most of the way across I was flying through rain clouds and fog banks. I couldn't see the ocean below me. Believe me, the land looked good after all those hours of flying."

The next day Captain Mollison flew to New York. There he had two experiences with the newest ways

of sending messages between distant parts of the world. These, just as much as traveling through the air, make the world seem smaller. First, Captain Mollison telephoned across the ocean to his wife in London, a thing which was not possible a few years ago. Then he was shown a newspaper in which was printed a picture of himself taken just before he left Ireland. It had been sent across by a device called telephote and had reached St. John about the time he had. The flier could hardly believe it possible. "What wonderful things they do nowadays!" he exclaimed.

In 1933, Mollison flew alone across the South Atlantic, from Africa to Brazil. Later that year he and his wife flew from Wales to New York. See if you can find out about other flights made either by Captain Mollison or by his wife. She also is a famous flier.

Each of these flights taught aviators something new. From some they learned about weather conditions in different parts of the world, and where the air routes of the future are likely to be. From others they learned how airplanes of different sizes behave on long trips. Still others showed how many hours engines will run in the air, and how much gasoline they use when flying long distances at high speed. All of them will help the men and women who make air voyages in the years to come.

WHAT TO READ

Handbook of the National Aircraft Collection (United States National Museum). P. E. Garber.

Brief accounts of early experiments and later achievements of fliers.

Heroes of the Air. C. C. Fraser.

Descriptions of the various types of machines used on famous flights.

The Lone Scout of the Sky — Lindbergh. J. E. West.

Contains complete instructions on how to make a flying model of the Spirit of St. Louis.

"The Non-Stop Flight Across America." J. A. Macready. *National Geographic Magazine*, vol. XLVI, no. 1, July, 1924.

"Our Conquest of the Pacific." C. E. Kingsford Smith and T. P. Ulm. *National Geographic Magazine*, vol. LIV, no. 4, Oct., 1928.

The Picture Book of Flying. Frank Dobias.

Begins with the old Greek legends and carries the story down to the flight of the Bremen in 1927.

THREE AMERICAN AVIATORS

Colonel Lindbergh's good-will flights — Admiral Byrd and his flights — Miss Earhart makes her records.

IF ANYONE were asked to write the names of five famous American aviators, he would surely include the three who are told about in this chapter. Of course no one could overlook Colonel Lindbergh. We have already read about the flight that made him famous and now we shall read about some of the others that he has made. After that we shall become acquainted with a great flier belonging to our Navy, Admiral Byrd, and with Amelia Earhart, a young lady who has proved herself one of our most skillful fliers.

Honors were showered on Lindbergh after his flight to Paris in 1927. For one thing, he was made a colonel in the Army. He was not in the least spoiled by any of them. He was still the same modest young American. Wherever he went he made friends. The people of many countries in Europe said that he did more to make them feel friendly toward the people of the United States than anyone who had ever been sent by our Government.

While he was in Europe, Colonel Lindbergh studied the air routes there. When he came home, he was able to tell our people many ways of improving our own. He has been busy in this work ever since.

Late in the summer of 1927, Colonel Lindbergh was sent on a tour of our whole country. Perhaps you saw him somewhere along the route, for he visited at least one place in each of our forty-eight States. In all he stopped at eighty-two cities and

towns. Everywhere he was welcomed by thousands of cheering people, but he attended closely to the real business of the trip. This was to find out everything he could that would help in planning new air routes and new airports. On this tour the distance flown was 22,350 miles, which is very nearly the distance around the earth at the Equator.

Before the year closed, Colonel Lindbergh began another important tour. About ten days before Christmas, our Government sent him on a "Good-Will Flight" to Mexico, South America, Central America, and the West Indies. This lasted two months, for the route was a winding one through fifteen different countries. The distance flown was about 9000 miles. The trip greatly pleased our neighbors to the south. It gave them a glimpse of our young hero of the air, whom everyone was eager to see. It showed them the friendship of the United States in sending to them a man who could suggest many helpful ideas about the new air routes that they were planning.

In 1931, Colonel and Mrs. Lindbergh made a good-will flight to Japan. When they arrived in Tokio they found more than two miles of streets decorated with flags in their honor. There was a crowd of 100,000 people, of whom 10,000 were on bicycles, all shouting "Banzai," the Japanese word for "Hurrah." At a reception Colonel Lindbergh made a speech that showed how pleased he and his wife were. Among other things he said:

"We have come to Japan for an opportunity of meeting your people and learning a little more of

the country which in our school days was known to us in America as on the other side of the world. When we were children, we thought of Japan as a land filled with people as different from us as though they lived on another planet. We have since found that you are very like us.

"We have already been very kindly treated by your people. We landed in an unknown part of your country, in fog and rain. The people of a village came to us. We spoke a strange language, but they took us to their homes and gave us a dinner of rice.

"Now we have been two days in Tokio. If we were to leave tomorrow we should take with us memories that are worth many times the efforts of our flight."

Every American who is old enough to be interested in transportation should learn all he can about aviation and what it means to people all over the world. Colonel Lindbergh, more than anyone else, proved how much it helps friendship between nations.

In the summer of 1933, Colonel Lindbergh and his wife flew to Greenland, and from there to Iceland, the Shetland Islands, and on to Copenhagen, Denmark, and to Stockholm, Sweden, to study the best Arctic air route to Europe. They visited many countries. Finally they flew back across the Atlantic to Brazil and then home. In all they traveled about 29,000 miles.

Admiral Richard E. Byrd is a famous explorer. In 1926, when a commander in our Navy, he flew with Floyd Bennett from Spitzbergen to the North Pole and back — 1530 miles in 15½ hours. On

Thanksgiving Day three years later, Byrd with two companions started from his camp in Little America and flew to the South Pole and back, about 1600 miles, in about 16 hours.

Because of his explorations and discoveries in the Antarctic regions, Commander Byrd was made a rear-admiral. He is the only man who has flown over both Poles in an airplane, but it is interesting to know that two days after his North Pole flight a dirigible balloon with the Norwegian explorer Amundsen aboard, followed the same route. This was the airship named Norge, which means Norway. She did not turn back at the Pole, but pushed on across the polar sea and landed in Alaska. Amundsen had been to the South Pole, too. In fact, he was the first man who ever reached it, but he traveled by dog sledge.

Between his flights to the two Poles, Admiral Byrd made a flight to Europe. This was in June, 1927. Three other American aviators went with him. They flew a monoplane from New York to the coast of France, a distance of 3477 miles. The time was 42 hours, 20 minutes. The fliers had hoped to reach Paris, but the weather was so foggy that they could not find the landing field there. They circled back to the seacoast, and finally had to bring their plane down on the water because they had used all their gasoline. The machine had no pontoons, but no accident happened to the fliers. They were able to paddle ashore in a small rubber raft which Commander Byrd had invented and which he had brought, folded up in a small bundle. He thought that it

might be useful if the plane was forced down while crossing the ocean.

Admiral Byrd's flight across the South Pole is one of the great deeds of recent years. His expedition was equipped better than any other that had ever gone into the Antarctic. Amundsen, who discovered the South Pole, and Captain Scott, the British naval officer who had been only a few days later than Amundsen in reaching it, had depended on dog teams. So had Admiral Peary when he explored the regions around the North Pole years before. But Admiral Byrd had arranged an easier way of traveling over ice, snow, and rocky land. He had dog sledges, of course, but he had also special automobiles called snowmobiles, and three big airplanes. He was thus splendidly fitted out to explore far and wide, and to do so more quickly and more easily than the men who had tried it before.

One of the airplanes was named Floyd Bennett in honor of the brave friend who had flown with Admiral Byrd over the North Pole, and who would doubtless have joined him in exploring the Antarctic if he had then been alive. But he had been one of the men who had gone to the rescue of the German airplane Bremen, whose story has already been told. This trip had cost him his life.

The flight of the Floyd Bennett across the South Pole is the most exciting adventure that Admiral Byrd has had. Soon after starting, the pilot saw some tall mountains close ahead. He feared that the heavily loaded plane might not be able to rise high enough to pass over them.

"Throw something overboard," he shouted to Admiral Byrd. There was not a moment to lose, for the airplane was speeding close to the mountains. There was great danger of crashing into them. Overboard went a big wooden case of provisions. The airplane shot upward, but not high enough. Again the pilot called a warning. Once more Admiral Byrd had to choose between his motion-picture cameras and his boxes of food. He knew that if the airplane was forced to land amid the ice and rocks of these mountains, the lives of his two companions and his own as well would depend upon having enough food. It would be a long, hard journey back to their camp. Nevertheless, he decided that the pictures telling the story of his flight must be saved. Again a heavy case of food was thrown overboard. Again the machine soared upward. The high mountains were crossed.

While they were passing over the Pole itself, Admiral Byrd dropped an American flag weighted with a stone which had been taken from Floyd Bennett's monument. He dropped also a British flag in memory of the brave Captain Scott who had died on his way back from the South Pole. Then the great airplane was headed back toward camp, and in a short time Admiral Byrd joined the main party of his men, bearing the good news of a successful flight. Perhaps sometime you will see the motion pictures that Admiral Byrd took on that flight. Anyway, you can read one of the books about the expedition. Paul Siple, the Boy Scout who went with Admiral Byrd, has written a very good one.

Miss Amelia Earhart is another flier who made the year 1929 famous. In June, as a member of the crew of the plane Friendship, she flew from Newfoundland to Wales. Almost all the way the man who steered had to find his way through fog, but he read his instruments well, and landed only a few miles from the spot he had aimed at.

Miss Earhart has written an interesting book, whose title "20 Hrs., 40 Min." tells us how long the flight was. Soon after this she married, but she did not give up her interest in flying. She had always wished to do what Colonel Lindbergh had done — fly the Atlantic alone. At last in 1932, her wish came true and she flew, without any companions, from Newfoundland to Ireland.

She had intended to fly to Paris, but all the way across the ocean she had met storms and fog, and near the coast of Ireland her airplane seemed to be working badly. So she decided to come down at the very nearest place, wherever it was. When she landed in a field, a herd of frightened cows galloped away, and an excited farmer came running up to see what accident had happened. "Where am I?" asked the flier. The farmer, who never guessed that the young lady had flown all the way from America, answered, "In Gallagher's pasture." He was much surprised when his visitor told him her name and where she came from.

Miss Earhart is the holder of four aviation records. She was the first person to cross the Atlantic by airplane twice. She was the first woman to fly across alone. She set a new speed record for the

route from America to Ireland, for she covered the distance of about 2025 miles in 13½ hours. Finally, she holds the long-distance flying record for women. She made this on her solo flight to Ireland.

If you watch the newspapers, you are likely to find more stories about Colonel Lindbergh, Admiral Byrd, and Miss Earhart. You will be interested also to watch for the names of other American aviators, who are doing things worth remembering. Whatever these men and women learn through their flights helps to make flying safer and a more useful means of transportation.

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The Boy's Story of Lindbergh, the Lone Eagle. R. J. Beamich.

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"The First Flight to the North Pole." R. E. Byrd. *National Geographic Magazine*, vol. L, no. 3, Sept., 1926.

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Lindbergh: His Story in Pictures. F. T. Miller.

"Seeing America with Lindbergh." D. E. Keyhoe. *National Geographic Magazine*, vol. LIII, no. 1, Jan., 1928.

"To Bogota and Back by Air." Charles A. Lindbergh. *National Geographic Magazine*, vol. LIII, no. 5, May, 1928.

HOW AIRPLANES ARE USED

The air mail — Airplanes for speedy travel — Suppose George Washington could have traveled by airplane — Friendly messengers of the air — Airplanes fight fires — How airplanes help the farmers — Airplanes are used in making maps — How airplanes help people in distress.

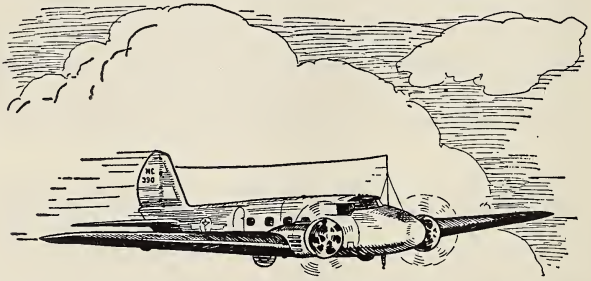
HAVE you ever counted up all the ways that you can think of in which airplanes are useful? First, of course, they are a very rapid means of sending mail and of traveling. We wonder how soon they will be going back and forth across the oceans as regularly as steamships do, and whether they will be larger than even the Do X or the American Clipper.

About twenty years ago our Government began to experiment with sending mail by air. We were the first country to do this. The first sack that ever traveled in this way was carried a distance of five miles or so in about six minutes and was then tossed out near a country post office. It fell several hundred feet. When it struck the ground, the sack burst open and everything in it scattered. The postmaster had to spend an hour or more gathering up the letters and postcards. There were 1800 of them.

Another flier tried to pick up mail sacks by dangling from his machine a rope with a hook at the end. Fishing for them in this way wasted whatever time was saved in the traveling. It did not take long to find out that the best plan was to have special places where planes could land and be loaded or unloaded.

The United States now has the best air-mail service in the world. The routes measure in all more

than 28,000 miles. How does that compare with the distance around the earth at the Equator? They cross our country in all directions and reach every important city. Half of all our people live in places that are reached by one or another of them. More than 8,500,000 pounds of mail are carried through the air every year. Some lines carry express packages also, and a few take passengers.



One of the latest American air-mail planes. She has two engines and a speed of 165 *miles an hour. There is room for ten passengers besides baggage, mail and express. These airplanes are built wholly of metal.*

The mail planes can carry 500 pounds of mail, which is about what 26,000 letters weigh. Their usual speed is 120 miles an hour. They can travel westward from New York to San Francisco, following a route 2700 miles long, in about 26 hours. This is 66 hours quicker than the fastest trains. Going eastward, the time is usually 24 hours, for the planes are almost always helped by favorable winds.

Newspapers printed in Oregon can be delivered in Massachusetts the day after they are published. You

can see how great a help airplanes are, not only to business men, but to everyone who wishes to know promptly the whole story of what is going on at the further edge of our nation.

Since much of the flying over air-mail routes is done at night, there are lighted beacons all the way. Every three miles there is a special kind of gas lantern whose light comes on whenever the sun stops shining. It is shut off whenever the sun comes out. Every twenty-five or thirty miles there is a small field where pilots can make a landing in bad storms or if anything goes wrong with the machine. These have electric beacons that throw their beams fifteen miles. Most important of all are the regular landing fields. These are 250 miles or so apart. They have houses, post offices, repair shops, supplies, and extra airplanes and pilots in case they are needed. They have very powerful revolving beacons, whose light can be seen by an airplane 130 miles away. Thus, you see, a pilot is never out of sight of one of these main landing fields.

The men on duty there know, of course, when a plane is due to arrive. They have their mail ready to put aboard it. In watching for mail planes they are aided by the strong searchlights on the wings of these machines. The pilot uses these when he is about to land. Mail planes have also, as you may have noticed, a red light on the left-hand wing, a green one on the right, and a white light at the tip of their tails.

Let us suppose that you have mailed a letter which is to go by air mail from New York to San Francisco.

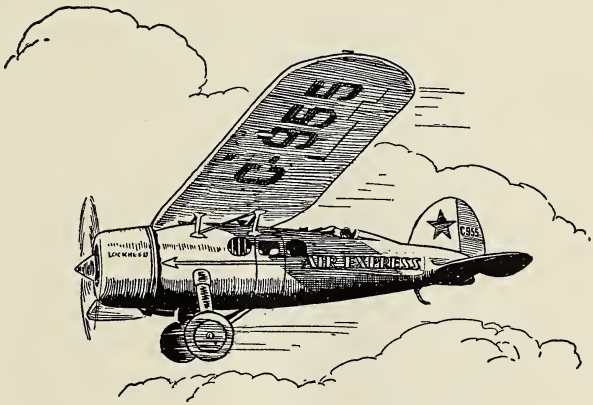
You used an envelope with broad red and blue bands across it, or else you fastened to it a sticker on which "Air Mail" is printed in large type. You paid a little extra postage. You posted your letter in a special red, white, and blue mail box marked "For Air Mail Only." A truck carried all the mail from this box to the landing field.

Promptly at noon the mail plane took the air. In the first zone, as it is called, reaching from New York to Chicago, three landings were made for taking or leaving mail sacks. Your letter reached Chicago early in the evening. There all the mail for San Francisco and cities along the way was put aboard another plane. This one flew all night and arrived at Cheyenne, Wyoming, just at daybreak the next morning. During the night it stopped at three of the regular landing fields. At Cheyenne the mail once more changed planes. After another day of flying, with five stops, the sacks were delivered at the San Francisco landing field just as evening was coming on.

Once in a great while a mail plane crashes and burns, and its load of letters is lost. But our air-mail service is very nearly as safe and sure as the railroad service. The motto on the post office in New York City reads, "Neither snow, nor rain, nor heat, nor gloom of night stays these couriers from the swift completion of their appointed rounds." These words were carved there with postmen in mind, but they apply even better to the brave pilots who fly our mail planes.

Mail from abroad also is speeded on its way by

airplanes. Fast seaplanes leave ocean steamships about a day before they reach New York, and land foreign letters and newspapers from Europe in less than four days from the time they left there.



This type of airplane is built for speed. Many records have been made by American fliers in planes like this.

When Colonel Lindbergh came back from France, he said that while Europeans thought our air mail very wonderful, they believed they were ahead of us in air transportation of other loads. Since that time we have done a great deal in planning air routes for passengers and light freight. For example, people can now fly from Newark, New Jersey, which has one of our best airports, to Seattle, Washington, in about 28 hours. Look up a map of the airways of the United States and see what cobwebs of routes there are. You will be interested, too, in the time-tables of the different ones.

If we wished to visit friends in Canada or Mexico, we should probably not try to go to both places in one day. But it would be entirely possible to do so if we flew our airplane as Major Doolittle, one of the most famous American fliers, once flew his. He had already made one record of 11 hours, 16 minutes, 10 seconds across the continent from coast to coast, making no stops. This showed how quickly a person could carry a friendly message from one end of our country to the other.

Now Major Doolittle wished to find out how quickly he could visit the capital of Canada, the capital of the United States, and the capital of Mexico, to carry greetings from the officers of one country to those of the other two. He left Ottawa one morning at about daybreak, and arrived in Washington in time for an early breakfast. He stopped for luncheon at Corpus Christi, Texas, and reached Mexico City a little after five in the afternoon. His time was 12 hours, 36 minutes, which is good proof that people who live 2550 miles apart, the distance between Ottawa and Mexico City, are made close neighbors by airplane.

In the days of George Washington, the only settlements were on or near the Atlantic Coast. He traveled through all the thirteen States either before or after he became President, but everywhere he went he had to go either on horseback or by coach. In some places the roads were so bad that only twenty miles could be covered in a day. It took three days or more to go from New York to Philadelphia.

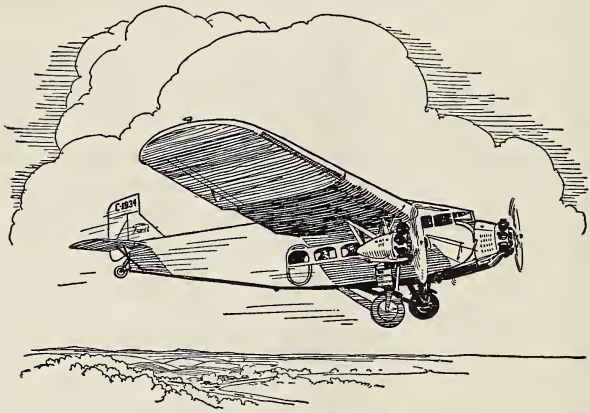
What would Washington say if he could hear of

the journey his great-great-great grandniece made in 1932? This lady, whose name is Anne Madison Washington, flew in an airplane 2900 miles between breakfast and dinner. Her pilot was Major Doolittle. As she stepped from his plane at the end of her journey, Miss Washington said happily, "I never traveled so fast before, and I hope never to travel by any other means." Part of the way the plane had flown at the rate of 210 miles an hour.

This flight started at Boston. After going north as far as the edge of Maine, Major Doolittle followed the coast as far south as Washington, D.C., where he stopped to get some gasoline. Then he went on to Yorktown, and circled over the places in Virginia, North Carolina, and West Virginia which Washington had visited. Ohio, Pennsylvania, and New York were other States over which the fliers hummed, dropping packets of letters at twenty or more airports. Finally they followed the Hudson River southward and made their landing at Newark, New Jersey. As you can see by looking at a map, they had followed a route which crossed fourteen States. It was just about equal in number of miles to all the journeys that President Washington ever made. Which of these States were formed after Washington's time?

Have you read anything in the newspapers lately that tells about other ways in which airplanes are being used, either here or abroad? Often you will find the account of the opening of a new airport, for all nations know that the best way to make air travel safe is to have plenty of up-to-date landing fields.

There are many hundred airports already built in the United States, and more are being built every year. Nearly fifty different companies have airplanes flying between important cities. American airplanes fly regularly to Canada, Mexico, and the West Indies, and to many parts of South America. Added together, these routes amount to 60,000 miles.



Airplanes with three engines are called tri-motors. They are used on routes between our large cities, and in many other countries. They are built of metal. Fifteen passengers can travel on these planes.

All parts of the world are reached by the airplanes of one nation or another. All together, outside of the lines in America, these routes cover nearly 100,000 miles. There are regular lines all over Europe. There is one between Germany and China, and another from Amsterdam to Java. The French have one from Marseilles to Bagdad, and the English have

one from London to Delhi, India. There is a route in Africa crossing the Sahara Desert from north to south, and some day it will probably go all the way to the Cape of Good Hope. In Asia, the Russian Soviet Republics have more than 10,000 miles of air routes. China has about 3000 miles and Japan about 2000.

So, you see, no matter how far away a land may be, the newest way of travel is being introduced there. The airplane is doing more than any other means of travel to make all nations near neighbors.

We are not so likely to think of the other kinds of everyday work that airplanes are doing. Here are some of them. They are used to patrol our great forests, watching for fires. Aviators make a note of the exact location of a fire and send the news by radio to the nearest fire fighters. This saves much valuable time, for the fire extinguishers can be brought up much more promptly than under the old system of telephoning.

Airplanes are used to spray orchards. That is, they fly over them and spread poison on the trees to kill bugs, flies, and worms that harm the fruit. Thus they save apple and orange crops.

In the South, airplanes spray the cotton fields to kill the boll weevil, an insect that attacks the plants. Poison powder spread from the air is said to cover the plants much more thoroughly than any applied by people working on the ground.

A little while ago men in an airplane flew over the city of Washington for about two hours and a half and took two hundred pictures of the streets, showing

buildings, monuments, parks, waterways, and other things. These pictures were all pieced together to show how the whole city looks from the air. A map like this made from the ground would have taken months or perhaps years to make, and it could not be as exact as this one is.

Explorers, like Admiral Byrd at the South Pole and Commander MacMillan in the Arctic, find airplanes very useful in studying and making maps of unknown parts of the world.

Ships in distress have been aided by coast-guard airplanes which carried lifelines to them. People in far-away places like Alaska, where travel overland is sometimes blocked by ice and snow, have been saved from sickness and starvation by the medicines and food brought to them by airplanes. The machines have been used to find people who have become lost.

A short time ago a little boy in a town in Mexico was sick with infantile paralysis. The doctor telephoned for an airplane and sent to a town in Texas for some serum, the only cure for this disease. It was three hundred miles away, but the airplane traveled so fast that the medicine was brought in time to save the boy's life. Our newspapers often tell of other helpful and neighborly things done by our skillful aviators.

WHAT TO READ

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"The Wings of the New West." E. L. Hampton. *Travel Magazine*, vol. LV, no. 4, Aug., 1930.

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HOW BALLOONS CAME TO BE

The first balloons — A flying barnyard — The first men to ride in the air — A new monster of the air — Americans become interested in balloons — Experiments with steerable balloons — The first dirigibles.

SOME of us have seen the great dirigible named Macon. She belongs to our Navy, and sometimes makes cruises to our chief cities. Most of us have read the story of the German dirigible named Graf Zeppelin after the nobleman who first learned to build airships of this sort. She has flown around the world and is now making regular trips between Germany and South America.

Like all the modern means of transportation, dirigibles grew from very small beginnings. If the little hot-air balloons that you see at county fairs and other public celebrations had never been invented, the world would never have seen such a giant as the Graf Zeppelin.

On an autumn evening about one hundred and fifty years ago, two brothers named Montgolfier were sitting beside an open fire in their cottage in France. The logs were blazing brightly, and clouds of smoke were flying up the chimney. One of the brothers suddenly asked, "I wonder if we could make smoke carry something up into the air?"

He probably did not know that hot air is lighter than cold air, and that this is the reason why smoke from a fire goes upward. He thought that there was something about the smoke itself that made it rise.

People have always wished that they could fly like birds, and this man had long been thinking about

some way to make this possible. He had often watched the clouds, which look so much like smoke, sailing overhead. Once he had told someone that if only he could catch part of a cloud in a paper bag, he believed he could ride on it.

The two brothers made a little fire in a pan. Then they held a paper bag over it, with the open end close to the fire. Soon the bag swelled. They let it go and it floated to the ceiling. Some of the smoke poured out through a window, and a neighbor, thinking the house was on fire, came running in.

The brothers told her what they were trying to find out. The neighbor asked why they didn't tie the pan to the bottom of the bag. This, she said, might keep all the smoke inside the bag.

The brothers thought this was a good idea, so the next day they tried it out of doors. They were delighted to find that their bag shot upward. It was carried to a great height, and traveled quite a distance before it dropped to the ground. Next they tried a paper bag lined with linen. This flew even better, so the brothers decided tc give a public exhibition.

When everything was ready, early the next summer, the market place of the village was filled with a great crowd. In the middle stood the two brothers with other men to help them. They dug a deep hole in the ground and filled it with straw and chopped wool, because these would make a great deal of smoke as they burned. Close over this they tied their huge bag of linen. This had a short neck and a round opening at the bottom. They set fire

to the pile of fuel, and as the bag filled with the hot air, it took eight men to hold it down.

The first balloon ever built. You can see the buttons and buttonholes that held the covering together.

When the bag had swelled into the shape of a great ball, a signal was given. The men let loose the ropes that held it, and the balloon instantly bounded into the air and rose higher and higher until it was only a speck in the sky. The wind wafted it along, and when it finally dropped to the ground, after floating in the air about ten minutes, it was a mile and a half from where it had started. There was great excitement because people believed that before long everyone who wished would be flying through the air carried by one of these wonderful bags full of smoke.

The first living creatures that were carried into the air, however, were not human beings. Nobody seemed quite ready to risk his life, after all. It was

therefore decided to see what would happen to animals when they were sent up in a balloon. So a basket was fastened to a linen bag, and a sheep, a rooster, and a duck were given a ride in the air. No harm came to them, except as the basket swayed about the sheep stepped on the rooster's foot. The three animals did not seem to know that they had left their own farmyard, for when they came back to earth they were contentedly eating the food which some kind person had placed in their basket.

About a year after the Montgolfier brothers made their first balloon, two other Frenchmen who lived in Paris decided that they would be the first people in the history of the world to ride in one. They used a balloon larger than any that had been made before. It was made of many pieces of linen, held together by buttons, and enclosing it was a network of cords. This balloon was gaily colored and decorated with many pictures. It was shaped like a lemon, and around the open neck at the bottom was a wicker basket. Below the neck, an iron gate to hold the fire was held by chains. Bundles of straw and wool were taken along as fuel, and there were buckets of water and sponges to use if the fire spread to the basket or to the cords that fastened it to the balloon.

Just as it started into the air, the balloon was nearly wrecked by a strong gust of wind. A little higher up, there was another narrow escape when one of the men became so excited by his new experience that he forgot to throw fuel on the fire. The balloon began to sink and barely missed striking the roofs of the houses.

The fire was started blazing again, and the next thing the passengers knew the flames were so high that the cords holding the basket burned nearly through. But the voyage ended well. After the balloon had been carried through the air for nearly two miles, the passengers let the fire die down slowly, and soon their basket gently touched solid earth. Just as the men stepped out, they were surprised to see the big bag, which had been swelled out with hot air, fall flat and empty on the ground.

Nowadays people who travel in balloons do not have to carry roaring fires with them. The gas bags of such great dirigibles as the Macon and the Graf Zeppelin are not filled with hot air, but with a gas that is many times as light as air. Sometimes the gas called hydrogen is used, and sometimes helium.

The first balloon filled with hydrogen was sent up from Paris in 1783, the year in which the Revolutionary War ended. There were no passengers. The day was windy and rainy, but a crowd of 100,000 people gathered to watch the trial of this new kind of balloon. A cannon was fired as a signal, and the balloon was let loose. It rose quickly and was soon hidden in the low dark clouds.

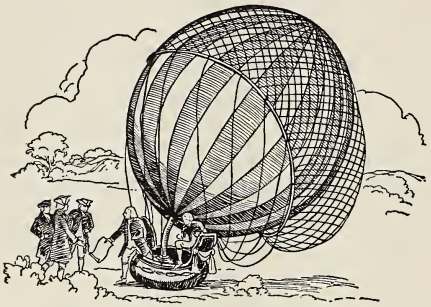
Some time later it fell in a small village several miles from Paris, where it frightened the peasants badly, for they had never heard of a balloon of any sort. When it touched the ground, it bounced along like a ball. The people thought it was a huge animal making great leaps. Even after the balloon lay on the ground, part of it kept moving because there was some gas left in it. A small crowd of men, women,

and children went as close as they dared to watch, as they thought, the dying struggles of an unknown monster of the air. By and by, a man bolder than the rest shot at the balloon with his gun. The people believed that the monster was badly wounded, and they rushed up with pitchforks, scythes, and hoes to put an end to it. One of them tore what he thought was the monster's skin, and out poured the hydrogen. Away the people ran, screaming for fear the poisonous breath would kill them. Finally, to get rid of this terrible creature, the peasants tied what was left of it to a horse's tail. The poor animal, as frightened as any of the people, dashed across the fields, and the new-fangled gas balloon was soon torn to pieces.

The first hydrogen balloons that carried passengers were very gay affairs. Some were striped red and yellow, or blue and white. Others were painted like flags. Ballooning became a very popular sport, and flights were made in many different countries. Surprising feats were done in the air. One balloon carried high above the ground a man mounted on his horse. The horse seemed to enjoy the ride as much as his rider did.

The first American who saw a flight of a balloon was Benjamin Franklin. He watched the first "fire balloon" of the Montgolfier brothers, and the one that carried the animals on their journey into the air. He saw also the first flight ever taken by men, and the ascent of the first hydrogen balloon. He wrote home to a friend that in time these globes, as he called them, would be very useful for traveling.

He thought the balloon so important an invention that a few years later he urged President Washington to invite a Frenchman named Blanchard to come to the United States and show our people how his balloon worked.



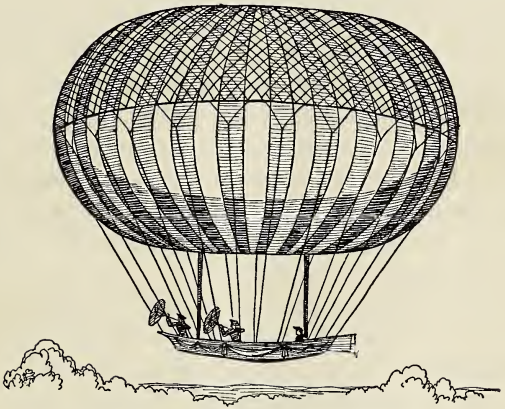
The first passengers in a balloon filled with hydrogen landing after their flight.

This flight was made from Philadelphia. People came from miles around to see it. The streets and squares of the city were packed with people. The near-by roads were crowded, too. Many people went up to their housetops, and even climbed church steeples. There were bands of music and salutes from cannon. Everyone seemed to realize that it was a great event. If those people thought that a small hydrogen balloon was so wonderful, what do you suppose they would have thought of a great dirigible like the Macon?

The first American to make a voyage in a balloon was Dr. Jeffries, of Boston. He and Blanchard crossed the English Channel from Dover to Calais

in about three hours. Their balloon had two wings and a rudder with which they tried to steer it, but they found that it whirled around a good deal, and always was carried in the direction that the wind was blowing. In the end, they landed safely, but it was in the top of a tree.

Men soon learned that they could make a balloon rise higher by throwing out the bags of sand that they carried as ballast. They could make it go lower by opening a valve in the gas bag and letting some of the hydrogen escape. But they had not yet found any way of steering a balloon.



One of the earliest dirigible balloons.

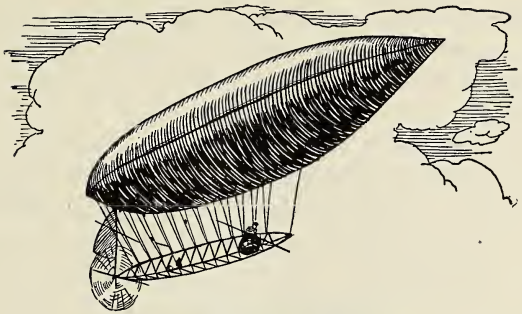
They tried many different ways. Some balloons had broad oars shaped like snowshoes. Others had rudders. One balloon was built in the shape of a cigar with arms or wings at the two ends like those

of a windmill. It was planned to propel another balloon by means of huge umbrellas. Her crew was to keep opening and shutting these umbrellas so as to make a wind that would drive the balloon ahead. They would steer in the same way.

One man followed the idea in the Persian fable that we told you about in the Chapter on "How Men Learned to Fly." He planned to tie several eagles to his balloon, and make them tow it along as they flew. Birds, he said, were the only creatures in the world that understood all about flying. He did not make it quite clear how he expected to guide the eagles in the direction he wanted to go.

Perhaps you have been in a boat on a river on a calm day. You may have found yourself drifting downstream, going just as fast as the stream went. If you tried to turn the boat by working the rudder, you discovered that you could not change your boat's course. If, however, someone with you started to row, so that your boat went faster or slower than the stream, you discovered that turning the rudder turned the boat.

The same thing is true of a balloon carried along by the wind. A balloon cannot be steered unless it is moving either faster or slower than the wind. The only way to control the speed of a balloon is by means of an engine. It cannot be rowed with oars because it is too heavy. It was a hundred years after the Montgolfiers' time when the first engine that could be used in a balloon was built. So it was not until then that there began to be steerable or "dirigible" balloons.



The Santos Dumont dirigible.

Santos Dumont, a Brazilian, was the first man who made a dirigible that really worked. For a while he lived in Paris, and he once won a prize by making an air trip of seven miles in half an hour. On the way he made a circle around the Eiffel Tower. He used a steam engine to drive his dirigible, and went higher or lower in the air by moving bags of ballast either forward or back in the car. One day his balloon began to fold up in the middle and to drop toward the ground. Probably some of the hydrogen had escaped. He saw some boys flying kites in a field below him. "Catch my rope and run against the wind," he called. The boys understood and did as Santos Dumont told them. His balloon acted like a kite on the end of a string, and little by little it was pulled safely to the ground.

The reason that this dirigible of Santos Dumont's folded up was that there was no framework inside the gas bag. The only thing that held it in shape was the pressure of the gas inside. The gas bag was

pumped so full of hydrogen that it was stretched tight everywhere. It was not a globe, like the first hydrogen balloon, but was more or less like a cigar in shape.

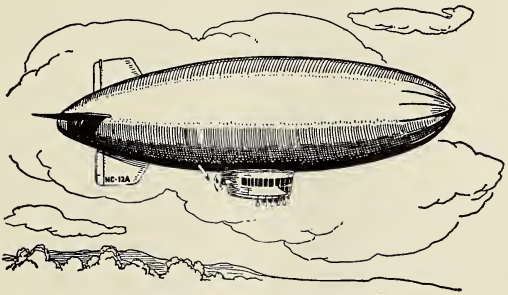
The German, Count Zeppelin, was the first man who thought of building a dirigible with a framework, or skeleton, of light metal. He arranged a dozen or more gas bags inside, and drew a skin-tight covering over the skeleton. This kind of dirigible is called rigid because it keeps its shape even if all the hydrogen is let out of the gas bags. You can see that no matter how hard the winds beat upon a dirigible that has a firm framework, they are not likely to make her bend in the middle. One of Zeppelin's first dirigibles was able to travel at the rate of eighteen miles an hour. This was a new record and seemed very fast indeed in 1900.

Dirigible balloons of another kind are called semi-rigid because they have a metal framework only at their nose. The rest of the body is kept in shape by the pressure of gas inside the bags.

There is a third kind of dirigible, the non-rigid, or blimp. They have this last name because the British call them limp balloons, and give all of them the letter "B" to show the class they belong to. Like the earliest balloons of all, blimps have no skeleton. They are simply pumped full of gas, which keeps them swelled out to the right shape.

Blimps are usually about one fortieth as big as the Macon, our largest dirigible. About ten passengers make a load for a blimp of ordinary size. Airships as small as this are not well suited to long voyages,

but they have several other uses. They are good for sight-seeing trips, for taking motion pictures from the air, and for experiments with the radio. They are used also in training men to fly larger dirigibles. Modern blimps have wheels under their cabins and so can run along the ground when taking off or landing just as an airplane does.



A modern blimp.

You are likely to hear dirigibles spoken of as "lighter-than-air" flying machines. This means that they are made to float in the air by means of bags filled with gases which weigh less than air does. Airplanes are spoken of as "heavier than air" because they are built wholly or partly of metal and other materials which weigh more than air does. They rise into the air by means of their propellers and wings. You have already read in the chapter "We Visit an Airport" a little about why they can do this. Another thing to remember is that airplanes are not held up by a gas that is lighter than air.

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The Mastery of the Air. W. J. Claxton.

Some of the chapters are: The French Paper-Maker Who Invented the Balloon; The Parachute; The First Attempt to Steer a Balloon; Count Zeppelin and His Airships; Semi-Rigid and Non-Rigid Airships.

SOME VOYAGES BY DIRIGIBLES

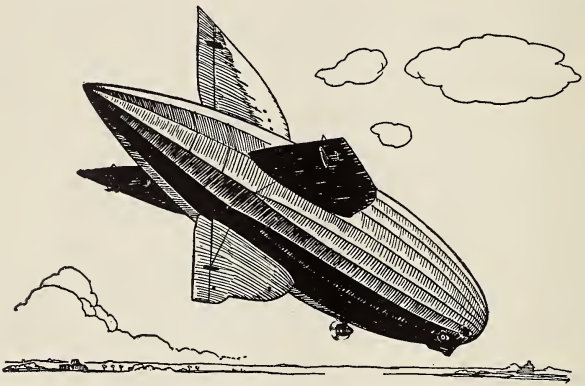
American and British airships cross the Atlantic — The world voyage of the Graf Zeppelin — How a great dirigible is managed — Hangars and mooring masts — How are dirigibles likely to be used? — Ocean airports.

WE COME now to the story of some famous voyages made by dirigible balloons. The first across the Atlantic was in 1919, when the British R 34 flew from England to Mitchel Field, Long Island, and back again. The name means that she was Rigid Airship No. 34. Going westward, she covered the distance of 3200 miles in 108 hours, 12 minutes. She returned in 74 hours, 56 minutes. On her flight eastward the R 34 was helped by favorable winds. While on her way she sent back this message: "Good-by, America! We thank you for your hospitality and we hope that the good relations of our two countries will continue forevermore."

The second airship to cross the Atlantic from east to west was the Los Angeles, which now belongs to our Navy. In 1924, she made a long flight of 5100 miles in 81 hours. Starting from Friedrichshafen, Germany, where she was built, she flew first across Europe and then across the Atlantic to Lakehurst, New Jersey. From shore to shore she took only 61 hours, even though she had to circle from the Azores to Newfoundland in order to escape a storm.

The most wonderful record made by an airship up to the present time is the around-the-world flight of the Graf Zeppelin, a German dirigible, in the summer of 1929. She set out from Lakehurst on August 8, and returned there in 21 days, 7 hours, and 34 min-

utes. Of this time she spent a little less than ten days in flying. The route that she followed was about 21,000 miles in length. Can you figure out about how many miles she flew in an hour?



The Graf Zeppelin. We are looking at her stern and see the rudders and fins that guide her through the air.

The Graf Zeppelin set a new record for a flight around the world, for the American airplanes that had made a similar journey had spent over fifteen days in the air, you remember. This airship set other new records also. She flew across the Atlantic in 55 hours, 24 minutes. She flew from Europe to Japan in 101 hours, 50 minutes. She was the first dirigible ever to fly across the Pacific. On this leg of her journey she flew 5800 miles in 78 hours, 58 minutes. This is less than one third of the time in which the fastest liner can cross the Pacific Ocean.

Perhaps the most interesting parts of the Graf

Zeppelin's long journey came when she flew over Russia and Japan, the lands which her passengers knew least about. The great dirigible passed over silvery lakes and rivers and wide stretches of thick forests, as well as over farming lands and cities. The windows in the cabins give a splendid view of the country below. They slope in such a way that the passengers can look almost directly downwards.

In the Russian cities great gold-domed churches could be seen, and buildings with strangely shaped towers. Out over the farming regions, the passengers in the Graf Zeppelin could see the peasants working in their fields and herding their flocks. Most of the Russian people had never seen a dirigible, and no doubt they wondered what the great monster was, and were frightened when she flew quite low over their heads. It is fortunate that no accident happened to the Graf Zeppelin while she was crossing the wilderness near the Arctic Circle, for if she had been forced to the ground so far from civilization, her passengers and crew might never have been rescued.

The people in Tokio, Japan, were delighted to have the world travelers visit them. They welcomed them with cheers and a public dinner, gave them all the help they needed in getting new supplies of food and fuel and in repairing their dirigible. When the Graf Zeppelin started on her flight to America, vessels of the Japanese Navy were sent to sea to help if there should be any mishap. The Japanese also gave the travelers some carrier pigeons, to use for sending messages if they wished.

Americans, too, helped to make the world flight of

the Graf Zeppelin a success. When she first set out from the airport in New Jersey, several companies of our Marines acted as her ground crew. All the way across the Pacific seven steamships of the Dollar Line were in radio communication with her. When she reached San Francisco, our soldiers and sailors drew the dirigible to her mooring mast, while thousands of cheering people welcomed her safe return. Finally, back at her starting place, Lakehurst, the Graf Zeppelin was given the most rousing reception she had received anywhere.

This flight around the world proved that people everywhere are interested in new ways of travel, and that they have the kindest feeling for visitors from foreign lands.

The Graf Zeppelin has for several years made regular trips between Germany and Brazil. Sometime, perhaps, she will make regular trips to the United States, too. If you ever see her flying over your town, hundreds of feet above the tallest church spire, you will of course realize that she is very big indeed. You will get a better idea of her size, however, if you ever see her closer to the ground, tied up to her mooring mast.

Huge as she is, the Graf Zeppelin is not the largest ever built. Our navy formerly had the Macon, which was even larger.

From end to end, the Macon was longer than a train of nine Pullman cars. From top to bottom she was as tall as a fourteen-story building. If she had ever stood straight up on her stern, her bow would have been very nearly as high in the air as the

flagpole on the Woolworth Building in New York City. If the cloth used in covering the Macon had been made into dresses, there would have been one apiece for 10,000 girls and women. The ship herself weighed 110 tons, and she could carry a load of 91 tons. She had a crew of 53, and space for 100 passengers. On one short flight the Macon's sister ship, the Akron, had 207 people aboard. This is the largest number that an aircraft of any kind has ever taken into the air.

Under a dirigible's bow is the control car, with windows like the bridge on a steamship. In this room the officers turn the wheels and move the levers that guide the ship. Here also is the radio apparatus. At her stern is the vertical rudder that steers her, the fin that holds her level like a boat's keel, and the horizontal elevators that make her go up or down. When an officer tilts the elevators downward, the ship rises. When he tilts them upward, she descends.

Along the sides are the propellers, four on the right and four on the left. The engines themselves are inside the airship's long cigar-shaped body. A dirigible is sometimes spoken of as a great "silver fish." This is because she is coated with aluminum paint. The reason for using this kind of paint is that the airship's gas bags are filled with helium, and aluminum paint shields it from the heat of the sun better than ordinary paint would. Helium does not catch fire as hydrogen does, and so is safer. But it is expanded by heat and therefore has to be protected from the sun's rays. The inside of the gas bags is painted black for the same reason.

As ballast a dirigible carries a great weight of water in other big bags. If she ever begins to nose down too much, an officer pulls a lever and dumps several hundred pounds of water out of one of the bags in the forward part of the ship. If she dips too much at the stern, he opens a water bag at that end. There is also another way of keeping on a level keel. Through the length of the ship runs a narrow walk called the "cat's walk" on which the nimble sailors pass back and forth while going about their work. The officer sometimes changes the airship's balance by sending a few of the crew toward one end or the other, for it does not take much shifting of weight to tilt one end of the ship up or down.

When all the engines are running at their full power, the fastest dirigibles can travel at the rate of eighty-five miles an hour. One could make a flight of more than ten thousand miles on the fuel that she carries, if she went at a slower speed, say sixty miles an hour. If she began her flight at New York, can you figure out how far east she could go before she had to come down for more fuel?

When a dirigible's officers wish to make the ship climb into the air as fast as possible, they can send her up at the rate of 1200 feet a minute. We can imagine how fast that is when we are told that the elevators in most office buildings do not run faster than 240 feet a minute.

When a dirigible finishes a flight, a great many men have to do hard and careful work. Imagine that you were in the crowd of people who once went to see a great airship return from a trip. It was

evening, for dirigible balloons always begin and end their flights while it is dark. The reason is that the earth throws off so much heat in daylight that it would expand the helium in the gas bags. The airship would bounce away from the ground like a rubber ball.

The people watching for the dirigible soon caught sight of her lights high up in the dark blue sky. They saw two red lights on the port or left-hand side of the ship, and two green ones on the starboard side. At the bow and also at the stern they saw two white lights. Every few seconds, the starboard and the stern lights blinked together, and so did the port and the bow lights. In answer, the airport's spotlights and floodlight were thrown upon the mooring mast, to help the great dirigible find her way to it.

The ground crew of three hundred men who were to help the dirigible make her landing were lined up beside a long strip of red, white, and blue bunting laid along the ground to show the exact direction from which the ship was coming.

The mooring mast was made ready. This is a pyramid made of steel lattice work, with a big round loop at the top, into which a big round knob on the tip of the dirigible's nose must be slipped. Doing this is somewhat the same as slipping a button into a buttonhole. In this way the airship is anchored. Near the bow of the dirigible is a large door which can be opened and lowered to make a sort of bridge. This is connected with the landing platform at the top of the mooring mast, when the people aboard the airship are ready to leave it.

An officer went to the top of the mooring mast and began calling out orders through a loud-speaker. "On your toes, now!" he shouted to the ground crew. "The starboard rope will be dropped first. Be sure that the starboard crew gets it! Don't let the fin touch the ground! We've got to move lively! Keep a firm steady pull on the ropes. Don't jerk."

The dirigible came nosing down toward the mooring mast. Her engines were roaring like fire engines pumping hard, and her propellers were whirling fast. Then, as she came closer, she slowed her engines and dropped two ropes. Each ground crew ran to one of them, and began to run to right and to left so as to hold back the airship.

When the dirigible's nose came almost over the mooring mast, other ropes were dropped and fastened to machinery that would pull them in. Slowly the ship came lower, and closer and closer to her mooring mast. At last the knob on her nose slipped into the loop on the mast, and the great ship stopped moving. Water was pumped into her ballast bags to make her so heavy that she would not rise from her anchorage. A huge wheel was fitted under the fin below her stern to make it run easily over the ground when she was towed into her dock or hangar.

Last of all, a tractor was hitched to the mooring mast and dragged both it and the dirigible into the hangar. The mooring mast itself runs on caterpillar wheels. The "orange-peel" doors were closed noiselessly behind the stern, the crew clambered down the ladders of the mooring mast, and the landing was safely ended.

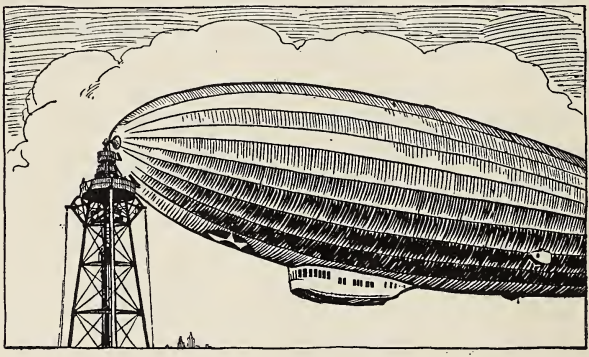
Where dirigibles are housed. The "orange peel" doors are opening, and a blimp is coming out. What gives us an idea of the height of this hangar?

The hangar in which the dirigibles are housed at Akron, Ohio, is one of the most remarkable buildings in the world. In the first place, it covers as much ground as the capitol at Washington, and is big enough for seven or eight football games to be played within its walls at the same time. It is shaped a little like an egg cut in halves lengthwise, the curved ends being the "orange-peel" doors. These doors are perhaps the most interesting thing about the building. You can guess why they are given this name if you have ever peeled an orange by cutting the skin into pieces the same shape as the sections of orange itself. The doors of this hangar fit together in the same way. When they are opened, they slide around the sides of the building and leave the end wide open. This gives plenty of room for the dirigible to be towed through. This hangar is the largest one in the world, but there is another at Lakehurst where the dirigible can be housed with considerable space to spare.

Other airports have mooring masts which are different from the movable one at Akron, the city where dirigibles are built. Instead of being towed from one part of the field to another, these masts are fixed firmly in heavy foundations, set deep into the ground. Outside them are elevators which carry passengers and crew to the ground. One at Lakehurst is 180 feet high, and another is 60 feet. The tallest mooring mast in the country is at the Ford plant, in Detroit, and is 216 feet high.

The mooring mast whose top is the highest above the ground, however, is the one on the Empire State

Building, in New York City. This building is the tallest in the world. It has 102 stories and measures 1248 feet in height. The mooring mast itself is 200 feet in length. What an interesting sight it would be if sometime when you went to New York you saw a great airship nearly 800 feet long with her nose made fast to this mooring mast so high above the city!



A dirigible, tied up to the mooring mast at Lakehurst. We see the control cabin and two of the engines.

One of the ships of our Navy has a mooring mast, so that it is possible for a dirigible to tie up to it without having to go to an airport when she wishes to anchor.

Many people believe that dirigibles are better for long voyages across the Atlantic or the Pacific than airplanes are. They are not so swift, but they can carry heavier loads. There is not so much space for passengers and freight in even the largest airplanes as there is in a medium-sized dirigible. The engines

of a giant airplane are likely to use 165 gallons of gasoline every hour. For a flight of twenty hours, the amount of fuel that an airplane would need would fill most of the space on the ship. There would be little room for anything else. Big dirigibles, however, would not be crowded with this amount of fuel, even with many people and many goods aboard.

It will be interesting to watch the papers and see what plans are made for air routes to Europe, and whether inventors find some way of making airplanes better suited to use on these routes than the dirigibles of today seem to be.

If there should ever come to be air liners flying regularly across the Atlantic or the Pacific, probably some kind of landing places would be built far out in the ocean. They would make the air routes safer.

Perhaps you have read about the huge floating islands that are already planned. These are to be several hundred feet long, to make a runway for airplanes. They will be wide enough to hold two dirigibles as large as the Graf Zeppelin side by side. There will be hotels and repair shops. These islands will stand so high above the surface of the ocean that the roughest seas will not break over them. Their sides will reach so deep into the water that they cannot be tossed about by any storm, and they will be firmly anchored to the floor of the sea. The plan calls for an island like this every six hundred miles or so all the way between America and Europe. Aircraft of all sorts will be able to take refuge on one of them if the weather forces them down.

No one knows when this plan will be worked out,

because air lines probably will not be common for some time to come. In 1932, however, a German company began a regular air service to South America. The first thing they did to make the route safe was to send out a big ocean liner to serve as a mother ship for the airplanes. She is ordered to cruise about over a certain part of the route, and to keep a sharp lookout for airplanes that need help. If she finds one that has been obliged to alight on the surface of the sea, she can hoist it upon her deck and repair it. Then she can launch the plane again by shooting it into the air by a catapult.

The United States Navy has two huge ships called airplane carriers, the Lexington and the Saratoga. A smaller one named Ranger has recently been built. These vessels are built for use in war time, and they have wide long decks with plenty of space for airplanes to land and take off. The funnels and deck houses are off on one edge of the ship, so that they are not in the way of the airplanes. The lower decks have storage space for eighty or more planes. There are also machine shops like those we see on the landing fields ashore. When you go down to one of these lower decks and see a small automobile running about on errands, you get a very good idea of how huge the vessel is. Vessels like these would make very good landing fields for air liners, if the Navy could ever spare them for that purpose.

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About Railroads

WE VISIT A GREAT RAILROAD STATION

Arriving at the Grand Central Terminal — What we see in the station — The railroad museum — The oldest train in America — "All aboard!"

WHAT a busy place the principal station in a big city is! In front of the entrances at almost any time of day we see long lines of private automobiles and taxicabs, each waiting its turn to leave people who are going away. Streams of other people pour out through the station doors on their way home or to business.

Some of the largest stations have six hundred or more trains going out or coming in every working day in the year. If each of these trains had ten cars, and each car had seventy passengers, how many travelers would enter or leave the station in a day?

The Grand Central Terminal in New York City covers so much ground that if thirty thousand people were in its public rooms at one time, they would not be crowded. What is the largest grandstand you know, and how many people will it hold? Another huge station in New York belongs to the Pennsylvania Railroad. On the busiest day this station has ever had, thus far, a total of about two million men, women, and children passed through its doors. That is almost as many people as live in the great city of Philadelphia.

Here we are at the Grand Central Terminal. At

the door a porter or "red cap," as he is often called because he wears a red cap as a part of his uniform, meets us and asks if we wish him to carry our suitcases. We are glad to turn them over to him, for they are quite heavy.

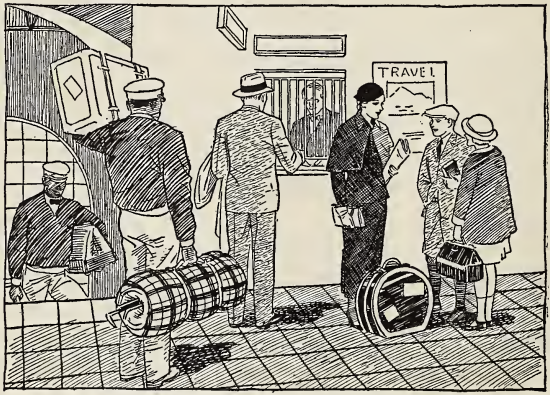
After a few steps, we enter one of the largest rooms, the concourse. This word means a place where people gather or come together. Along one side are windows where travelers buy their tickets, and on the other are the gates through which they go to or from their trains. Some stations have two concourses, one for outbound and one for incoming passengers.

The outbound concourse in the Grand Central Terminal is so immense that a building twelve stories high would not touch the ceiling. When we look straight up, it is almost like looking at the evening sky, for the ceiling is painted blue, with clouds and groups of stars.

We have come to the station quite a while before our train leaves because we plan to get our luncheon there. We have several errands to do too. We therefore ask the porter to go with us to the parcel room, where we can check any bags, bundles, coats, or umbrellas until we call for them.

Next we stop at one of the ticket windows and buy the rail tickets for our trip. Since our journey is to be from New York to Chicago, we go also to the window where Pullman tickets are sold. After that, if we have trunks as well as hand luggage, we go to the baggage room and check them to Chicago. Here we see such huge piles of trunks, big suitcases and

bags, that we wonder whether they can ever be sorted out and sent on the right trains. The work, however, is done by careful men, and mistakes are not often made. We may be sure that our trunks will be in the baggage car on the same train that we take.



Buying our railroad tickets.

Now we are ready for our luncheon. We find that we can choose between a number of different places. There are several up-to-date hotels near the station; and in the station itself there is an excellent restaurant. If we are not very hungry, we can have sandwiches and ice cream at a lunch counter in another part of the station.

After luncheon, we find that we still have some time before our train leaves, so we decide to stroll around the station. There seem to be many interesting things to see. We glance into the waiting rooms, where hundreds of people are sitting until it

is time to go aboard their train. We notice that the seats on each bench are numbered, so if some of our party wish to rest for a while, we can easily find them again.

Along the ends of the waiting rooms are counters where we can buy books, magazines, newspapers, gifts, postcards, or candy and salted nuts. Elsewhere in the station are little shops in which the things that travelers are most likely to need can be bought. We see umbrellas, rubbers, shoes, neckties, and handkerchiefs, hats, stockings, gloves, and dozens of other articles. There is a drug store and even a flower shop. The station has also an express office and a branch post office. Here and there are telephone booths, and desks where we can write telegrams.

Next we go into the concourse again. A line of people is waiting near a booth over which hangs a sign reading "Information." Inside two or three men are as busy as they can be answering questions. We hear one passenger ask when the next train leaves for Buffalo. Another wishes to know the number of the track on which the train from Boston will come in. Several people ask for time-tables of different railroads. The men inside the booths seem to have at the tips of their tongues all the information that any traveler could possibly want. If they are not able to answer a question instantly, they are sure to have close at hand a book to which they can refer. It is interesting to see how rapidly one line of inquirers melts away, while another forms. We wonder how many thousands of questions are an-

swered every day by these patient, busy men at the Information booth.

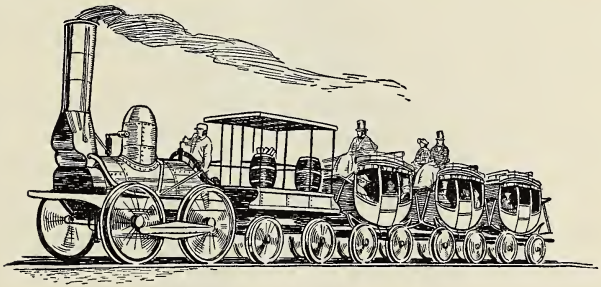
In the concourse, too, is a big bulletin board. On this, from time to time, the latest news about incoming trains is posted. Usually there are in a station many people who have come to meet friends returning from a journey. This bulletin board tells them whether a certain train is on time, or how many minutes late it may be. It tells also the number of the track on which it will come in.

Some stations set aside spaces in the concourse for exhibits of different kinds. There may be a railroad museum where there are pictures, models of trains, pieces of old-fashioned rails, and so on. There may be a show case in which some of the things made in the city or State are displayed. You can often learn from these exhibits lessons in history or geography that you will remember longer and more clearly than the ones you read in a book.

In the museum of the Grand Central Terminal, we see the oldest railroad train in the United States. It is not the first one ever used, but it is the only one saved from the olden days. This train is made up of a locomotive, a tender, and three small passenger cars. The whole train is about as long as the locomotive and tender on a train of today.

The name of the locomotive is DeWitt Clinton, in honor of the man who was governor of New York at about the time when the first railroad in that State was built. This was a little more than one hundred years ago. The railroad's name was the Mohawk and Hudson, and its tracks ran between Albany and

Schenectady, a distance of about seventeen miles. It is now a part of the New York Central Railroad. On special occasions this old DeWitt Clinton train runs over the tracks it used so long ago, to show people how trains looked in the early days of railroading.



The DeWitt Clinton train.

The locomotive burned wood, not coal. The tiny tender was loaded with piles of wood for the fire and with barrels of water for the boiler. When these were used up on a trip, as sometimes happened, the passengers helped the engineer to draw water from wells and to cut more wood. The engineer stood on a little platform at the rear of the engine, but the captain had a seat, high in the air, at the rear of the tender. The passenger cars are old-fashioned stage-coaches, with a door at the center of each side. There are seats for six people inside each coach, and for four others on the top of each. Each coach, instead of running on its own wheels, is fastened firmly upon a small platform car with big iron wheels that fit the railroad track.

When the train started, the captain gave warning

by blowing a big tin horn. There was no bell, and no whistle. Then the engineer opened the throttle, the driving wheels began to turn, and the train moved ahead with such jerks that some of the passengers' hats fell off. Smoke poured from the tall smokestack, and the passengers sitting on the top of the coaches were showered with sparks from the burning wood.

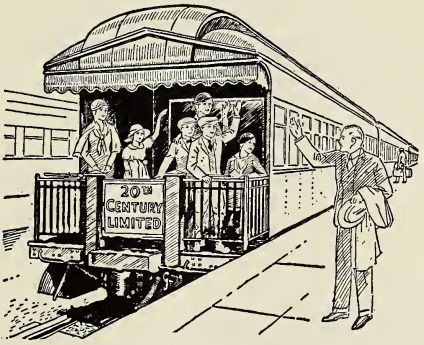
A man who rode on this train on its first trip said that some of the passengers opened umbrellas to shield themselves. At the end of the ride, there was nothing left of the umbrellas but the handles and the ribs. Whenever the train stopped, the coaches bumped together so hard that most of the passengers were sent flying from their seats. In those days there were no air brakes on the cars, to bring a train gradually to a comfortable stop.

The DeWitt Clinton made the run of seventeen miles in about an hour, stopping several times along the way. Part of the time it ran at the rate of thirty miles an hour, which seemed too fast to be safe.

It is time now to get the luggage that we wish to have with us in our car, so we call another red cap, and again visit the parcel room. There is no delay in handing us our things, and off we start toward our train. We tell our porter what train we are going to take. There are twenty or more tracks along the side of the concourse, so the porter tells us the number of the track where our train is.

As we walk past the different tracks, we notice that there is a gate at the end of each which is kept closed until that particular train is ready for passen-

gers. Then the gateman puts in place a bulletin board which shows, below the number of the track, the starting time for the train, and the list of the stations at which it will stop.



All aboard for Chicago!

The gateman looks at our tickets and we step aboard the train. Our porter finds the seats that our Pullman tickets call for, and stows our luggage away near-by. We settle ourselves comfortably and get ready to enjoy an interesting ride. In a moment our long train of heavy cars starts so gently that we can hardly tell it has begun to move. Out from the station it glides, with little noise except the clicking of the wheels as they cross from one track to another.

In just nineteen hours we shall arrive in Chicago, one thousand miles from New York. How much faster we shall travel than the DeWitt Clinton train could go!

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How a boy and a girl learned about engines, cars, and stations.

Trains, Tracks and Travel. T. B. Van Metre.

Tells all about railroads, locomotives, passenger cars, freight cars, tracks, stations and terminals, and how trains are run.

The Ways We Travel. Frances Carpenter.

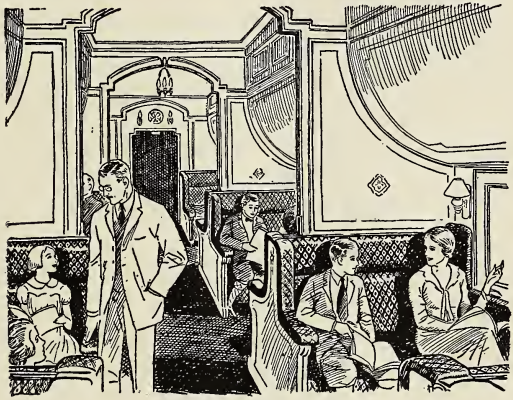
Chapter IX. On a Fast Express Train.

A MODERN EXPRESS TRAIN

Our sleeping car — Views from the car window — Our dining car — We inspect the train.

THE name of our train is The Twentieth Century Limited. "Limited" means that it is made up largely of Pullman cars and that the number of passengers is limited to the number of seats. Most of the cars are sleepers, and we find them very different from ordinary day coaches.

On each side of the aisle are seats roomy enough for two people. They are arranged in pairs. That is, if there are four people in a family, two will ride facing the front of the train, while the other two ride backwards.



In a Pullman car.

We soon find out the reason for this arrangement. At bedtime the porter fixes these seats so that their edges touch, puts a soft mattress across them, and makes up a comfortable bed. This is called a lower

berth. The upper berth is right above it, and is brought into position by pulling down a wide shelf which through the day has been hidden behind curved panels in the roof of the car. This berth is fully as comfortable as the lower one, but some people do not like it so well because, when they go to bed, they have to climb up a little ladder.

Each of the two berths has electric lights, a mirror, hangers for clothes, shelves, and a small hammock in which to put things. There is a push button to ring the porter's bell if we need to call him before morning.

When we want to get ready for bed, we draw curtains across the front of our berths. We are separated from the next berths by partitions that reach from the floor almost to the ceiling. It is a good idea to notice the number on our curtain, for there is no other way of telling our own berths from the others. After we wash in the morning, and come back from the end of the car where the little washroom is, we should hardly wish to surprise anyone else by pulling aside the curtains at the wrong place.

A lower berth and an upper berth make what is called a section. Pullman sleepers have also a few bedrooms in which there is one regular bed and a sofa instead of two berths one above the other. These rooms have their own washstand and a folding table on which meals may be served. Still nicer rooms, called drawing rooms, are larger and have both upper and lower berths and also a lounge which can be made up into a bed. Families in which there are small children like these private rooms better

than a section, because there is more space for the little ones to move about. Also, it is not necessary to use the public washrooms. It is pleasant through the day to sit in the main part of the car where we can get acquainted with the other passengers. On a long train ride, however, we might enjoy closing a door and making ourselves as much at home as if we were in our own house.

All the trains leaving the Grand Central Terminal travel underground for several miles. The tracks run under the city streets and their tall buildings. To avoid smoke in the tunnels, powerful electric locomotives are used. After an hour's ride a big steam locomotive which can draw us seventy miles an hour is fastened to our train, and we speed along the bank of the Hudson River. Let us keep our eyes open for interesting sights, watching especially for those that have to do with travel or transportation.

As we approach Poughkeepsie, we see a great railroad bridge crossing the river. You will be interested to find out how far up the Hudson big steamers can go. Also, to learn the different ways in which bridges are built so as not to interfere with ships passing them. Another chapter in this book tells about bridges.

At Albany, several Pullman cars that have come from Boston are attached to our train. A little beyond Albany, we pass through Schenectady, where many locomotives are built, as well as wagons, agricultural machinery, motor fire engines, and electric motors. Our train soon crosses the Erie Canal, about which you will read in another chapter. Here

we have a glimpse of the canal boats on their way from Buffalo to the Hudson River. Before long we reach Syracuse, where we are surprised to see that our train passes along a busy street, crowded with automobiles. Electric power brought from Niagara Falls drives the trolley cars here and in near-by cities.

Soon we look at our watches, for we are beginning to feel hungry. When a waiter in his white jacket passes through the car, and rings the chimes which say "First Call for Dinner," we decide that it is time to get something to eat. So we follow him into the dining car.

We find the chairs and the carpet a pretty shade of blue. The tables and the chairs are mahogany. At the end of the car we pass by the kitchen and pantry which, we are told, are equipped as completely as those in any up-to-date hotel. There is even an electric refrigerator. The kitchen is so tiny that we do not see how the two cooks can work without getting in each other's way. Next is the sideboard, with brightly polished silver dishes and shining mirrors. Beyond that are tables along the two sides of the car, some seating four people and some seating two. In all, thirty-six people can be served at one time.

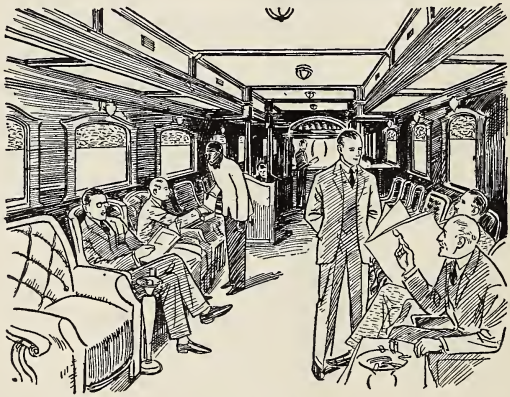
The linen is spotless and there is pretty china and glistening silver and glassware. Each table has its vase of fresh flowers. Already we are sure that anyone who sits down at one of these attractive tables will have a good appetite. When we look at the menu, we find that it offers as many different things as we could expect in any hotel.

Dinner time on the Twentieth Century Limited.

In the old days of railroading, no food was served in any train. If the passengers got hungry, they could do one of two things. They could eat the food they had brought with them from home, or, if they had none, they could only wait until the train stopped somewhere for "refreshments." There were a few stations with lunch counters where sandwiches, pies, and fruit were sold, and at these places the train stopped for twenty minutes or so.

The only thing that passengers could get in the train itself was a drink of water. Now and then a boy would walk through the train carrying a large tin can with a long spout, something like the watering pots we use in our gardens. If you were thirsty, he would pour a glass of water for you. What do you suppose the railroad travelers of those days would say if they could see a modern dining car?

After dinner, we go on a tour of inspection through the whole train. We come first to five or six sleepers like our own. As we pass from each car to the next, we find that every platform is a closed vestibule so that there is no risk of anyone's being jolted off a platform. In the old days there might be an iron gate across the car steps, but neither the platform nor the roofs joined tightly. In walking through a train, people had to step carefully when passing from one platform to another, and if the weather was stormy, the rain or snow beat in from the sides and from overhead.



In the club car.

Following the last sleeper are two interesting cars. When we go into the club car, we find it hard to believe that we are on a train. This car has most of the things that make a club house attractive. In a smoking room are big leather armchairs and

lounges, shelves of books, a desk for writing letters, racks of magazines and newspapers, and tables for playing games. There is a radio, too.

Some of the most up-to-date club cars have barber shops and even shower baths. There may be, also, a soda fountain, which we should hardly expect on a train. There may be also a little buffet, where sandwiches and salads are served.

The last car is a lounge car, arranged especially to please the ladies. There are many comfortable chairs and sofas and reading tables and desks with lamps. There is a radio here, too, and a buffet like the one in the club car. Sometimes there is a ladies' shower bath.

Toward the rear end of the lounge car is a glass screen reaching to the ceiling, and beyond that is a sun parlor with high, wide windows and wicker furniture. Here half a dozen friends can sit cozily together, chatting and enjoying the scenery. Beyond that is the platform, wide enough for several more chairs, and shaded with an awning. This is a favorite place for people to ride when the weather is fine.

Now it is bedtime, so we retrace our steps to our own car. We find that the porter has made everything ready for the night, so we are soon snuggled under the blankets, and the next thing we know we are all called for breakfast.

At the breakfast table we look at a map in our time-table, and find that during the night we have passed through a number of places whose names we have heard. Among them are Erie, Pennsylvania,

and Cleveland and Toledo, Ohio. These are important ports for the freight steamers on Lake Erie. They ship or receive great cargoes of iron and copper ore, petroleum, coal, fruit, and grain.

After breakfast our train makes its first stop for leaving passengers since we started from New York. This is Elkhart, Indiana. Soon after this we skirt the southern end of Lake Michigan, and before we know it we pull into Chicago through busy railroad yards and reach the end of our journey.

Chicago is the greatest railroad center in the world. Twenty-seven important lines have their terminals here. Probably more than half of all the miles of tracks in our country belong to these roads.

There are six huge stations. Each of them takes care of anywhere from one to six different lines. There is a belt railroad that runs around three sides of the city, and connects these terminals. All passengers and freight can thus be carried from the tracks of any railroad to those of any other.

We go to see the new Union Station because it is as fine as any in the world. It fills two enormous buildings on opposite sides of the street. The concourse is very different from those in the two great stations in New York City. Across its walls and ceiling extend the giant steel trellises and girders that hold them up. They are not covered with marble or plaster, and remind us of bridge work. They look very businesslike. The station's waiting room is interesting because of its tremendously high ceiling.

We learn that Chicago is expected to become our

country's greatest airport center. Already it has seventeen landing fields, used by six different airways.

Measuring from the Atlantic to the Pacific, the city is hundreds of miles east of the halfway point. It is, however, almost exactly at the center of the nation's industry and business. That is the reason why the means of railroad and air transportation have developed as they have around Chicago. The city is our most important gateway between the East and the West.

WHAT TO READ

Famous American Trains and Their Stories. Roger Reynolds.
This book begins with the De Witt Clinton train and ends with the stream-lined trains of today.

How the World Rides. F. C. Fox.
Chapter II. The Railroad Train.

How We Travel. J. F. Chamberlain.
Chapter V. Traveling by Train.

The Wonder Book of Inventions. Harry Golding.
There is an interesting chapter on "Recent Railway Inventions."

THE STORY OF THE PULLMAN CAR

The oldest Pullman car in the world — The newest Pullman car — A "parlor car" — How Pullman cars help safe travel — The wanderings of a Pullman car — Each Pullman car has a name — Some special trains have names.

WE HAVE been so delighted with our ride on a train of Pullman cars that while we are in Chicago we go through the factory where they are built. Here we find no end of interesting things. What we enjoy most is our visit to the oldest Pullman car in the world. It shows us the great differences between the crude little Pullman cars of seventy-five years ago and the big, safe, comfortable ones of today.

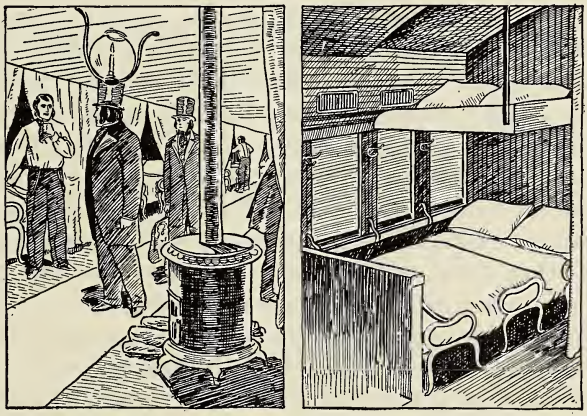
"No. 9," as this oldest Pullman car is called, is hardly bigger than a one-man trolley car. It is only about half as long as our car on the Twentieth Century Limited, and it weighs less than a quarter as much.

When we step inside, we find the ceiling so low that a tall man has to take off his hat to walk under the lamps that hang over the aisle. There are three of these lamps, and we see that they are not really lamps at all. They are just iron brackets with one candle in each.

At each end of the car is a little iron stove, with a pile of chunks of wood beside it. That is the only way in which this Pullman could be heated. There is also a small washstand with a tin basin, and a tank of cold water. The floor is bare except for a narrow strip of carpet in the aisle.

The wooden seats are covered with carpet, but they

have no springs and no cushions. We try sitting in one, and decide that we should not wish to ride very far in a seat like this. We surely would not enjoy trying to sleep on it either. The backs of the seats are hinged, so that at night they could be let down flat. Then a thin mattress and pillows were laid across them, sheets and blankets were tucked in, and the tired travelers went to sleep if they could. The beds were almost as hard as a board. Still, cars fitted up in this way were thought very wonderful.



These two pictures help us to understand what the oldest Pullman cars were like.

Old "No. 9" is a great contrast to one of the sleeping cars of the latest type. We find one that has just come from the factory standing on a near-by track. It is the kind used for long journeys of several days and several nights, and quite different from the

one we rode in from New York. The first thing that we notice is that it is divided into fourteen little bedrooms. If a number of people are traveling together, the doors between one room and the next can be opened. A narrow passage running the length of the car has other doors opening into the different rooms.

There are real beds with mattresses as soft and springy as those we sleep on at home. The floor has a thick carpet, and there are pretty curtains at the windows. The porter shows us a chair and asks us to fold the back down. What do you suppose is inside? A washstand with running water, hot and cold. We find also a thermos bottle for drinking water. The room has steam heat, which we can turn off or on as we wish, and there is an electric fan. The window has a ventilator so there is always fresh air. There are plenty of electric lights, one of which is at the head of each bed. There is space for hand baggage under the bed, a closet in which passengers can hang their clothes, and a box for shoes. There is also a tiny dressing table, with a mirror.

Altogether, each room in one of these newest Pullman sleepers is a very complete little bedroom on wheels. A journey in it is sure to be not only comfortable, but also an interesting adventure.

Before we leave the factory, we visit also one of the Pullman coaches that is used only for daytime travel. This is the kind that we often see coupled into a train of ordinary cars. It is not nearly so elaborate as the sleeper in which we traveled on the Twentieth Century Limited, or as the splendid car we have just inspected. We can see, however, that on a ride of

two hundred miles or so, it would be much more comfortable than a railroad's regular cars.

Along each side of the aisle, a Pullman coach has a row of big single chairs with deep cushions and high backs. The floor is carpeted, and in front of each chair is a footrest. The chairs are fastened to the floor, but can be turned completely around, so that two people can face each other when they wish to talk. There is a wide window close beside each chair, so we can watch the scenery and all the interesting sights along the way. There are electric fans, window screens, and other things to make us comfortable.

Many of these cars have tiny kitchenettes so we can have our meals brought to our chairs. The porter will set a small table in front of us on which we can eat our meals, or play games, if we wish.

Pullman cars were the first ones to be built of steel inside and out. This makes them safer in case of a train wreck because steel does not splinter as wood does. Nowadays if we see a wooden car, we know it is an old one. Steel cars last longer than wooden ones, and they run over the rails more steadily because they are heavier and not so likely to sway from side to side. When we look at the trucks at the ends of a Pullman car, we notice that each of them has six wheels. This is another thing that makes these cars run more smoothly than everyday ones whose trucks have only four wheels, two on each side.

The Pullman Company is now beginning to build some cars of aluminum. This has been found to be as strong as steel. Of course it is much lighter.

Pullman cars were the first ones to have vestibules. Now nearly all passenger coaches have them, too. Vestibules are the covered platforms at the ends of the cars. They have solid floors, parts of which fold away when the train stops at a station, so that passengers can use the steps. There is no space, as there used to be, where a careless person might catch his foot between the platforms of two cars. The roof of each car is joined to the next one by folding hoods, and there are doors that close tightly at the edges of the platforms. Passengers, you see, can walk through the whole length of a train without going out from under shelter. There is no risk that anyone will be jolted from a platform when a train speeds around a curve.

Vestibules add to safety in travel in another way, too. If there should be a collision between two trains, the vestibules would not crumple up the way the open platforms did. They would also keep a car from climbing up on the next one, a thing that sometimes happened in the old days.

There are about nine thousand Pullman cars in the United States today. Most of them keep going back and forth over the same miles of track on the same railroad. Others roam all over the country. In one month a few years ago, one of them visited Toronto, Miami, Los Angeles, and New York, and many cities along the way. During the whole year it traveled almost 150,000 miles and took people to most of the interesting places in our country, north, south, east, and west. It was traveling 309 days out of the 365.

Most Pullman cars belong to the company that built them. They are hired by the different railroads for use on their long-distance trains. Each Pullman car, we have noticed, has its own name. Some are named for people, some for mountains or rivers, and a great many for places. Sometime when you go on a railroad journey, keep a list of a dozen or so of the Pullman car names that sound most interesting. Then when you get home, look in the encyclopedia or the atlas and see what you can find out about these people and places. The other day a boy saw a Pullman car named Samuel P. Langley. Do you know why this man is famous? If you saw the car named Nokomis, could you tell what poem that name came from? If you saw one marked Mount Vernon or Lafayette, you would of course think of George Washington and our Revolutionary War.

Sometimes a railroad chooses the names to be given to the Pullman cars that it uses. The Northern Pacific Railroad has a train made up of cars named for celebrated Indian chiefs. Perhaps you have read about some of these Indians. Here are a few of their names: Chief Black Bear, Chief Fire Heart, Chief Iron Tail, Chief Little Raven, Chief Red Cloud, Chief Rushing Eagle, Chief Sitting Bull, and Chief Standing Buffalo. The tribes to which these Indians belonged lived in the land along the border of Canada all the way from Minnesota to Washington. If you ever travel in that part of our country, you will hear many stories about how some of these red men made friends with the first explorers there,

and how others fought against the building of railroads across their lands.

Many railroads give names also to special trains. There is one named The Spirit of St. Louis in honor of Colonel Lindbergh's famous airplane. Sometimes a name gives the idea that the train is very fast, such as the Red Arrow run by the Pennsylvania Railroad from New York to Memphis, or the Golden Arrow from New York to Chicago.

The Union Pacific has a beautiful train running between Chicago and Denver. It is named The Columbine after the State flower of Colorado. Each car is named for some flower or tree that grows there, and is painted with broad bands of blue and silver, striped with gold. Can you tell why these colors were chosen?

One of the best trains on the Central Railroad of New Jersey runs between New York and Atlantic City. Its engine and all the cars are painted blue, trimmed with brown, and the train is called The Blue Comet. Each coach has the name of some star.

The Boston and Maine Railroad has The Flying Yankee running between Boston and Portland, Maine. Perhaps you can tell why the Union Pacific Railroad has one between Chicago and Portland, Oregon, called The Portland Rose, or why one of the same railroad's trains between Denver and Chicago is called The Mountain Bluebird.

It is easy to guess why The Rocky Mountain Limited runs over the Rock Island Railroad between Chicago and Denver, and why The Overland Limited is a good name for a Southern Pacific train between

Chicago and San Francisco. Still another well-named train is The Sunset Limited on the Southern Pacific between New Orleans and San Francisco. If you hunt through the time-tables of our great railroads, you will be able to make a long list of the names of trains.

The train named The Yankee Clipper on the New York, New Haven, and Hartford Railroad has cars named for the splendid American sailing vessels called clippers that made wonderfully fast voyages before the days of steamships. They were the most beautiful ships that ever sailed the seas. Perhaps you have seen pictures of some of them.

The most famous name is Flying Cloud. This ship sped around Cape Horn on her way from New York to San Francisco in 89 days. No sailing ship ever beat this record. Another clipper, the Lightning, made the longest day's run ever made by a sailing vessel, 436 miles in 24 hours. This is farther than any steamship of those days ever traveled in one day. Both of these records have, of course, been beaten by modern steamships. The remarkable thing about them is that they were made by vessels that used only sails.

Other very fast ships were named Comet, Surprise, Sovereign of the Seas, and Red Jacket. You will be interested to read stories about these clippers and others, especially if you happen to ride in a railroad car named for one of them.

WHAT TO READ

"The Pullman Car." W. E. Ekblaw. *Home Geographic Monthly*, vol. 1, no. 9, March, 1932.

The Train Book. W. C. Pryor.

What a boy and his sister saw on their first over-night railroad journey.

Railroad Booklets.

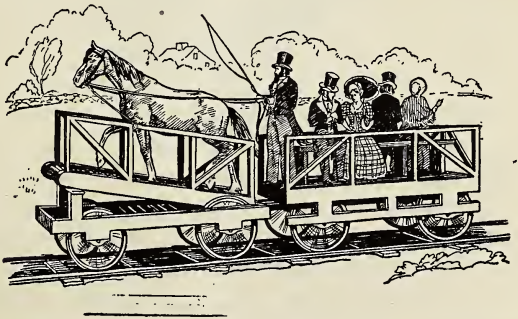
The Pullman Company issues a series of advertising pamphlets that tell all about its cars new and old. The railroads whose trains are mentioned in this chapter have printed descriptions of them, which you can probably obtain from the general ticket offices in our larger cities. Other railroads also distribute illustrated circulars. Among these are: Atchison, Topeka and Santa Fé, the Canadian National, the Canadian Pacific, the Chicago, Burlington and Quincy, the Chicago Great Western, the Great Northern, and the New York Central.

WHAT OLD-TIME TRAINS WERE LIKE

Before the days of locomotives — The first steam locomotives — How the rails were laid — Why the engines had cowcatchers — How the trains were run — Why sleeping cars came to be — When engines and cars were gaily colored.

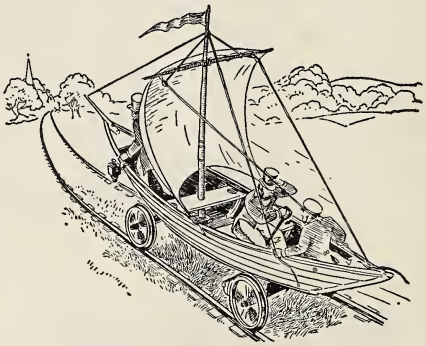
WHEN we visited the museum in the Grand Central Terminal in New York, we saw an old-time train and learned something about its first trip. Now let us learn a little more about what was done even before the time of the DeWitt Clinton.

The very first railroad in the country had only fifteen miles of track. Instead of locomotives, it used horses to draw its cars. It was a great event when a single car filled with people pulled into the station at either end of the line. The car ran back and forth several times a day, beginning at ten in the morning and making its last trip at five in the afternoon. For two hours in the middle of the day, horses and drivers rested.



The treadmill train.

After a while, someone built a treadmill, or moving platform, on a car and set a horse to walking on it. The treadmill was like an endless chain connected to the wheels in such a way that as the horse walked, the wheels went round and moved the car forward. On the trial trip, all went well until a cow grazing near the track was frightened by the clatter of the machinery. She charged against the car and upset it. The passengers were sent rolling down an embankment and, when they picked themselves up, they were so angry that the inventor decided his scheme was not worth trying any further.



The sailing car.

Another idea was a sailing car, arranged to run on rails. It was a large bowl-shaped basket in which the passengers sat, with a mast and sails like those of a boat. The trouble with this plan was that if the wind blew west, west the sailing car must go, even if the passengers had gone on board wishing to travel

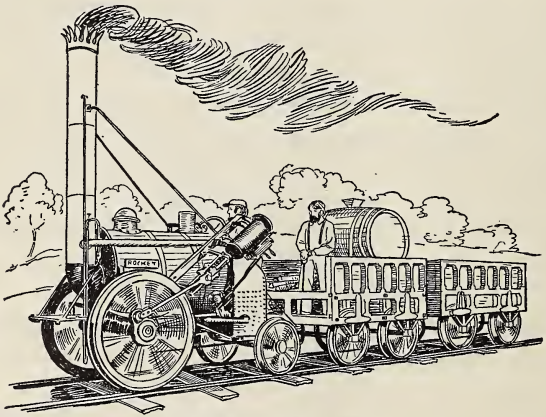
east. One day a party of fifteen was sailing smoothly along in one of these cars when suddenly the mast and sail were blown overboard. This accident showed another reason why sailing cars could not be depended on.

While these ideas were being tried in the United States, men in England were learning how to build steam engines that would run on rails. The first that drew trains were given a trial a little more than one hundred and twenty years ago. One was called Catch-Me-Who-Can, and another Puffing Billy, for reasons which you can easily guess. No matter how hard any of these first engines puffed, they could not go faster than twelve or fourteen miles an hour.

People were very timid about riding on trains drawn by these new machines. They said that the wheels of the coaches would fly off if the engine ran too fast, or that the boiler would burst. The farmers who lived near the railroad did not like the engines, either. They were afraid that the smoke would kill the hens and chickens, and that the sparks from the smokestack would set fire to their houses and barns, and to the thick woods. One of them thought that the red-hot smokestack would frighten his cows. He was not much comforted when the engineer asked, "How will they know it isn't painted?" To guard everything as well as possible, a man on horseback was sent galloping ahead of the train to warn people that it was coming.

The best of the early locomotives was built in 1829 by an Englishman named Stephenson. It was named The Rocket. One day someone said to Stephenson,

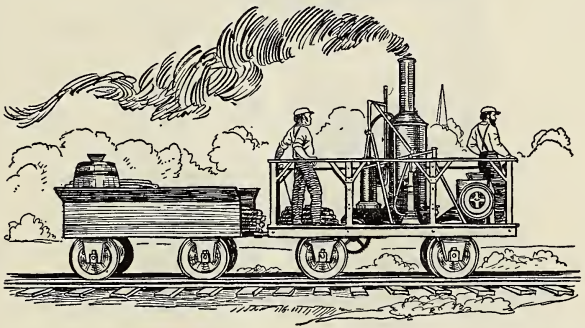
"If a cow should get in front of your engine when it was going fast, what would happen?" If this man expected to be told that the engine would upset, he was disappointed. Stephenson answered, "Sir, it would be very bad for the cow." Another man had so little faith in the new engine that he said that if it went faster than ten miles an hour, he would be willing to eat one of the wheels. Fortunately for him, Stephenson did not hear him say this, for when The Rocket was tried, it made a record of thirty-six miles an hour.



Stephenson's locomotive, "The Rocket."

In the summer of that same year, an American named Peter Cooper built a tiny steam locomotive which, because of its size, was known as Tom Thumb. The boiler, which stood on end, was about as big as the hot-water boilers you see attached to kitchen ranges. With its smokestack it looked like a big

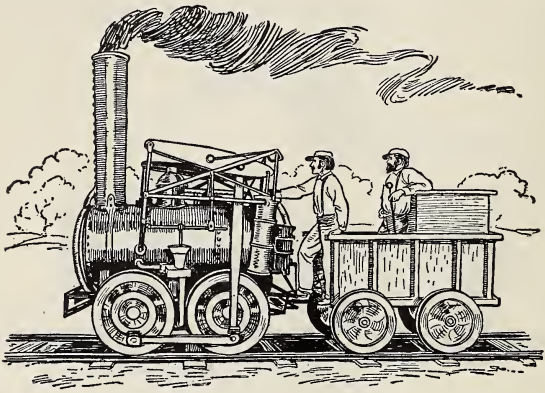
bottle. This engine was given a trial on the Baltimore and Ohio Railroad, the same one that had used the treadmill car and the sail car. A few improvements were made, and the next year the Tom Thumb surprised everyone by pushing a car containing twenty-four passengers a distance of thirteen miles in an hour.



"Tom Thumb." This engine was named after a very small but very strong man who lived in the days of King Arthur.

A few days afterward there was a race between the Tom Thumb and a horse-drawn railroad car. At the word "Go" each started, amid the cheers of the passengers and the onlookers. The big gray horse sprang away instantly and was soon far ahead. When the Tom Thumb finally got up steam, it began to gain, and after several miles it went ahead. The driver of the horse lashed his steed furiously, the horse ran faster than ever, and for a little distance the race was very close. But the horse, not being run by steam power, could not keep up such speed, and presently began to drop behind. It looked as if

Tom Thumb would win, when suddenly something went wrong with the machinery. The engine slowed down, the big gray horse forged to the front, and held his lead until the end of the race.



"The Stourbridge Lion."

Railroad men, however, firmly believed that a steam engine was the thing to use. One company sent to England and bought a locomotive named The Stourbridge Lion after the little town where it was made. This one had so many levers perched up on top of its boiler that people said it ought to be named Grasshopper instead of Lion. It was tried once or twice, but was too heavy for the bridges it had to cross, and so was given up.

Americans, however, learned a number of things about building locomotives from studying The Stourbridge Lion and the John Bull, another engine

brought from England at about the same time. The John Bull is now on exhibition at the National Museum, at Washington, D.C. When you see this engine you will be interested to notice that it has a cowcatcher, a headlight, a bell, and a whistle, all of which were added in this country. In England, railroads ran between fences, but in the United States they ran through the open country, and there was nothing to prevent men, women, and children, to say nothing of animals, from getting on the tracks. The bell and the whistle were warning enough for people, and the cowcatcher worked well in pushing animals out of the way without hurting them.

The first locomotive built in the United States for regular use on a railroad was named The Best Friend. It belonged to a road in South Carolina. When this engine made its first run, one of the cars in the train carried a cannon and some soldiers. While the engine puffed proudly along, this cannon was fired over and over again. Probably everyone for miles around knew that something unusual was going on.

The Best Friend came to a sad end. A man was one day helping the engineer, and became annoyed by the sound of steam constantly hissing through the safety valve. He found that he could stop the noise by sitting on a lever that closed the safety valve. He therefore kept on sitting there, until with a blast louder than any cannon, the boiler exploded and the poor Best Friend was nothing but a pile of junk. Fortunately nobody was hurt except the man who caused the accident. Even he was not hurt badly.

For a number of years after this, railroad trains had a car known as a barrier car between the locomotive and the rest of the train. It was loaded with bales of cotton, and the idea was that if the engine blew up, the bales would keep the flying pieces from hitting the passengers.

Many of the early railroads used wooden rails, with a heavy strip of iron spiked on top. Sometimes these strips worked loose, and one end curled up. Then, when a heavy car ran over it, the piece of iron poked a hole through the floor. This, of course, frightened the passengers, who were sure that the car would be thrown from the track. The train stopped until the engineer could pound down the snake head, as the curled end of the iron was called, so that the train could run over it.

The first sleepers, or ties, that the rails were laid on, were sometimes blocks of stone and sometimes heavy timbers. The first car wheels were made of wood and had iron flanges to keep them from slipping off the rails. These flanges were on the outside edge of the wheels. Is this like the car wheels of today?

A locomotive usually had a sort of big shovel fastened on in front which pushed out of the way things that got on the track. Once a passenger who was riding on an engine saw a cow lying on the rails a little ahead. The train could not be stopped and it looked as if the cow would certainly be killed. Instead of that, the shovel scooped her up and carried her a few yards. Then the cow fell off beside the track without being hurt at all, while the train went along as if nothing had happened. Some locomotives

pushed big brooms along the tracks, to sweep them clean.

The trains did not run very fast. One day the President of the United States had a special message that he wanted to send from the capital to Baltimore. An engineer was told to make the trip as fast as he could. Faster and faster the train roared along, until it was going at the rate of thirty miles an hour. Suddenly there was a hiss and a jolt. The train stopped. The fireman had become frightened at riding so fast. He had poured water on his fire and put it out.

Most railroads had no regular time-tables. One advertisement said that steam trains would run on a certain line "three times each day during the warm season, and twice a day during the cold season, excepting Sundays." If anything happened to delay a train, there was no way of sending word ahead, for the telegraph had not been invented. No one at the stations along the line knew when the trains would arrive. Shortly before a station agent thought that a train might be coming, he would climb to a perch on top of a tall lookout pole. If he saw smoke in the distance, he shouted the news to the people on the ground. If there was no smoke, he just sat up there, and waited.

On the earliest trains there was no conductor. The engineer took up the fares. At first these were not even tickets. When the engineer took a passenger's money, he put a chalk mark on each man's hat. Later on there were conductors, and tickets came into use. When the conductor took them up he gave

each passenger a slip of paper, much as he does nowadays after collecting your ticket.

At first there were no baggagemen, so the trunks were put on and off the train by the firemen. Hardly any of the engines had cabs, and both the engineer and the fireman stood on an open platform in all kinds of weather. Often they had to drive the trains through storms that wet them to the skin.

For a long time there was no glass in the doors and windows of the coaches. There were only leather curtains to keep out rain, snow, and cold winds. There was at first no way of lighting or heating the coaches, but after a while oil lamps and coal stoves came into use. People who sat near the stoves were too hot, and those who sat farther away almost froze.

The seats had no springs and no cushions. While a train was running, the passengers were tossed roughly up and down. When a stop was to be made, the brakemen put on the brakes by hand. They turned cranks or wheels at the end of the coaches which wound up the chains working the brakes. The train lurched and swayed, and the passengers were jolted this way and that almost as if there had been a collision. The cars were fastened together by chains, and whenever the train stopped there was a great clanking and bumping as each car slid against the car next ahead of it.

For a number of years American railroads ran their trains only during daylight. When it grew dark, all trains stopped and the travelers spent the night at the nearest tavern. This was often an uncomfortable thing to do, so by and by the railroads

began to run their trains at night. There were no electric headlights on the locomotives. Even kerosene lamps had not been invented. The first headlights were small bonfires of wood, built on little platform cars which the engines pushed along in front of them.

Before Mr. Pullman worked out the ideas that we saw in "No. 9," sleeping cars were made from ordinary day coaches by building along the sides ten upper and ten lower berths. These were like the narrow wooden shelves in the canal boats of those days. Some cars had three tiers of shelves, close above one another. There were mattresses and pillows, but no sheets or blankets. People took off only their outer clothing, which they used as bed coverings. Usually they kept their boots on. We can easily believe that no one slept comfortably, especially when we are told that two people were expected to crowd into each of the lower berths. The upper berth was narrower, so only one person tried to sleep there.

Little by little improvements were made, but your grandfather can tell you that even when he was a boy many of the railroad cars were very uncomfortable in comparison with those in which we take our journeys.

There was one plan that railroads almost always followed years ago. Later it was given up, but recently it has begun to come back into fashion. This is the painting of locomotives and cars in attractive colors. Some of the old locomotives were bright green, some dark red, and some bright red.

They usually had trimmings of shining brass. If a locomotive had a black boiler, as some of them did, it was likely to have a red smokestack and perhaps red wheels.

For passenger cars the usual color was yellow, probably because the first American railroad coaches had been painted in that way. The newer ones simply followed the old style.

Another reason for so much color was that before there were any railroads, people used to ride in stagecoaches and private carriages that were gaily painted. Travelers seem always to have found more pleasure in making their journeys in prettily decorated vehicles.

A railroad is usually a smoky, dusty place. The reason that the railroads gave up using bright colors was that they found that it cost too much money to keep fresh paint on their locomotives and cars. They began to use darker shades that did not show dirt quite so quickly. Perhaps when electric locomotives become more common, or when some other way is found of getting rid of cinders, the railroads will go back to the old plan. Some day we may see trains as gay as the automobiles that fill our streets and highways.

Already there are a few special trains dressed up in colors, like The Minute Man of the Boston and Maine Railroad, which wears buff and blue. Can you tell why these colors were chosen for that train? You may live in a part of the country where the Pennsylvania Railroad trains run. If you do, you know that both their locomotives and cars wear

dark red. Sometimes they are trimmed with a little brass. However, most cars are still painted in dark, practical colors, like the olive green of most Pullman cars and many ordinary coaches.

WHAT TO READ

"America's First Railroad." Gilbert Grosvenor. *National Geographic Magazine*, vol. LI, no. 2, February, 1927.

"Building America's First Railroads." A. C. Laut. *Travel Magazine*, vol. LIII, no. 1, May, 1929.

How They Carried the Mail. Joseph Walker.

Chapters X. When Steam Was Harnessed to Sails; XI. The Snort of the Iron Horse.

When Railroads Were New. C. F. Carter.

The World We Live In and How It Came to Be. Gertrude Hartman.

Chapter XVII. The Iron Horse.

LOCOMOTIVES GREAT AND SMALL

When engines had names — Why locomotives are not all alike — The locomotives of passenger trains — Engines for freight trains — The largest locomotive in the world — Electric locomotives — Which is more powerful, a steam or an electric locomotive? — Where electric locomotives are used — Locomotives with motors — The roundhouse.

IN THE early days no railroads thought of giving their cars or trains special names as so many are doing nowadays. The railroads were all very proud of their engines, however, and to many of these they did give names. There were the George Washington, the Benjamin Franklin, the Lafayette, and dozens of others named for famous men.

There was also the Old Ironsides named in honor of the famous frigate Constitution, which as you know was nicknamed in this way. Once an engine was named Perseverance, which probably meant that it kept right on trying, no matter how hard the work seemed. Another was the Pioneer.

Some locomotives were named for animals such as Antelope, Buffalo, Camel, Elephant, Lion, and Reindeer. Others bore the names of creatures that live only in story books, like Pegasus, Dragon, and Unicorn. There were such names as Volcano, Arrow, Hercules, Comet, and Giant. Perhaps you can guess why these names were chosen. Probably the names of States, cities, rivers, and mountains were used more than any others.

Nowadays we do not often see a locomotive with a name, because railroads have found it simpler to use only numbers. The Baltimore and Ohio Railroad,

however, has named twenty of their fast locomotives after the first twenty Presidents of the United States. The Boston and Maine Railroad has an engine named the Paul Revere. Do you know any others?

You have seen locomotives of many shapes and many sizes in the stations and the freight yards of big cities. Have you noticed how they differ in the number and the size of their driving wheels and in the way these wheels are arranged? Have you ever been told why locomotives are not all alike, or how the different kinds are used?

Perhaps you would like to know what a railroad man means when he says that a certain locomotive belongs to the Pacific class, or the Mikado class. These and others are a sort of family name for locomotives.

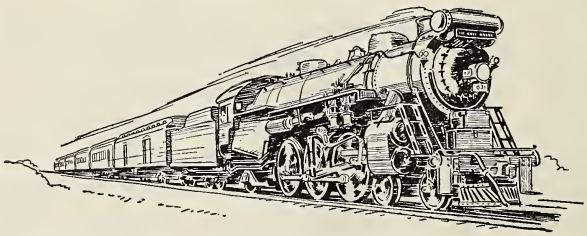
Another way of telling to which class an engine belongs is to count the number of wheels. For example, 4–6–2, means that on each side under the truck at the front end the locomotive has two small wheels, then three driving wheels, and back of them one small wheel under the cab; 2–8–2 means one small wheel, four driving wheels, and then another small wheel on each side. Remember that the whole number of wheels is twice what you see on one side.

We can usually tell whether a locomotive is used for drawing passenger trains or freight trains if we notice the size and number of the driving wheels. The larger a wheel is, of course, the farther it travels along the track each time it revolves. An engine whose driving wheels are as tall as a man is built for speed and is used on fast express trains. One with

smaller driving wheels and more of them is able to keep up a long, steady pull, and is better for hauling heavy loads of freight.

On the next few pages are pictures of a number of the different kinds of locomotives that we are likely to see as we travel in the United States. Look at them carefully and read what is printed under each of them, and you will have a very good idea of each class, or family.

Pacific type locomotives, called also 4–6–2, are favorite ones for fast passenger trains. They are named Pacific because they were first used on railroads whose trains ran through the western part of the country to the Pacific Coast. Now they are common on railroads in the East, too.



A locomotive of the Pacific type, used on many fast passenger trains. Compare with the Royal Scot, on page 185.

Sometimes on the front end of the boiler is a thing that looks like the rolled-up blanket on a soldier's knapsack. This is where water is heated before it is let into the pipes inside the boiler. This helps to make steam faster.

Other splendid locomotives used on fast passenger

trains are the Northern and the Hudson types. The first of these travels through the mountains of Canada where there is snow most of the year. The engineer and fireman ride in a glassed-in cab as snug and warm as any passenger car. The front end of the tender is covered, too, so that when the fireman gets coal, he does not have to step outside into the freezing weather.

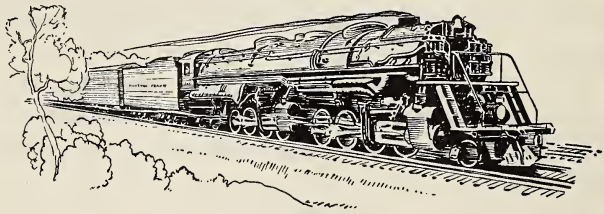
If we see a locomotive with a 4–6–4 arrangement of wheels, we may call it either a Northern or a Hudson. Which one it is depends on whether it has a special cab or not.

The Twentieth Century Limited, on which we rode from New York to Chicago, is drawn most of the way by a locomotive of the Hudson type. Like the Northern, these engines are built for high speed. They also are able to keep the train moving steadily and smoothly.

Locomotives of the Hudson type are about four times as long as the little old locomotives of about a hundred years ago, such as the one that drew the DeWitt Clinton train.

When you see a locomotive whose wheels are arranged in the 2–6–0 plan, you will be quite safe in saying that it is a Mogul. If there are four driving wheels on each side, instead of three, and if the engine is longer and heavier, you will probably be right if you call it a Consolidation engine. Mogul engines are used on both passenger and freight trains. Consolidation engines are used only on freight trains, especially those that are run at the slower speeds.

The fastest speed at which a steam locomotive has ever drawn a train is 112½ miles an hour. This record was made in a short run by engine No. 999 of the New York Central. Regular passenger trains hardly ever travel faster than sixty miles an hour.



Mallet locomotives can haul the longest, heaviest freight trains over the steepest slopes.

Mallet locomotives are named for the French railroad man who invented this type. The first ones were used in Switzerland and in Russia where trains have to climb steep grades among the mountains. Today in the United States there are more than two thousand of them, which is probably more than any other kind of freight engines. Some have as many as eight driving wheels on each side and can pull the heaviest freight trains up any slope.

An oil-burning Mallet locomotive.

In the western part of our country we sometimes see Mallet locomotives that look as if they were run-

ning backward. The cab is at the front end, and the smokestack is back close to the tender. The reason for this is that among the mountains there are many long tunnels. If the cab was at the rear end of the locomotive, the engineer and the fireman could not see through the thick clouds of smoke that would pour into their faces. This locomotive burns oil, and the fire is at the end where the cab is. We may wonder how the fireman gets his fuel. It is brought from the tender through a big pipe. The tank on the tender holds five thousand gallons, which is more than enough for the longest trip these locomotives have to make.

Mallet locomotives are really two engines built into one. This is so that a single engine may have as much power as two usually have. Strange as it may seem, they are jointed in the middle so that they can go around sharp curves. Before it was discovered how to build locomotives in this way, long freight trains often needed two engines. Usually one was at the head of the train and the other at the rear. If there were a hundred or more heavy freight cars in between, you can see how hard it was for the engineers to be sure that they were going to start or stop their two locomotives at exactly the same time.

The locomotives known as the Mountain type or 4–8–2 are likely to be used on special freight trains that run on a time-table just as passenger trains do. Some of these trains are loaded with only one kind of freight. It may be automobiles, or building materials, or clothing, or milk. There is always a reason why it must leave one place and arrive at another at a certain time.

Santa Fé or 2–10–2 locomotives are named after the railroad that first used them, the Atchison, Topeka, and Santa Fé. They are well suited to hauling heavy freight trains on long trips, as for instance between Chicago and the Pacific Coast.

The fire box on a locomotive as powerful as this one is likely to be as big as a small room, perhaps ten feet long, about seven feet wide, and six feet deep. The tender will probably carry as much coal as your father would buy to heat an eight-room house for twelve months or more. There is machinery that keeps feeding coal into the fire box so that the fireman does not have to shovel coal by hand.

Mikado locomotives are used on the fastest freight trains. Often they haul trains wholly made up of refrigerator cars.

The first Mikado locomotive was built in the United States for the Emperor, or Mikado, of Japan. Many of the same sort have been used on our own railroads ever since. They are fine fast engines, and the best kind for hauling freight trains loaded with fresh fish, fruit, or vegetables that spoil quickly. Their driving wheels are so big that we may mistake a Mikado for a passenger engine. When we notice the 2–8–2 arrangement of wheels, however, we can name the type correctly.

Decapod is a word made from two words meaning ten-footed in the language of the ancient Greeks. The wheels of locomotives of this type are arranged 2–10–0. They are much used in Pennsylvania and in Maryland to take coal trains over the mountains. Their many driving wheels distribute the weight more evenly. Another thing that helps them to pull steadily is the rather small size of these wheels. You know that the locomotives that draw fast passenger trains often have driving wheels six feet or more across. The large wheels are for speed, and the small ones are better for the strong, steady pull.

The men who built the first steam locomotives would rub their eyes if they could see the immense engines that thunder over our shining rails today. They would find it hard to believe that these great machines are the great-grandchildren of the tiny engines that they invented.

A very big machine always seems more wonderful than a small one, and we are interested to know about the locomotive which at the present time is the largest in the world. No locomotive continues to be the largest or the most powerful very long, for no matter how huge it is, another monster bigger yet is sure to be built sooner or later.

Today, the largest steam engine in the world belongs to the Northern Pacific Railroad. It was at the Century of Progress Fair in Chicago in 1933. This monster is 125 feet long from the tip of its pilot, or cowcatcher, to the end of its tender. If stood on end, it would be as tall as a ten-story building. When loaded with fuel and water, it weighs almost 75 times

as much as the DeWitt Clinton with its tender. It has 34 wheels in all, of which 16 are driving wheels.

This great locomotive can haul a train three times as heavy as the ones drawn by an everyday big freight engine. In a test, it has hauled a train more than a mile long, made up of 150 freight cars. Perhaps you can tell about other locomotives very nearly as powerful as this one, such as the one known as No. 8000 on the Canadian Pacific Railway. Possibly you will soon read in some magazine the news that some American railroad has built another locomotive that has set a new record for size and power.

Some locomotives, as we learned when we traveled on the Twentieth Century Limited, run by electricity instead of by steam. As you can see from the picture, they look entirely different from the ones that we have been reading about.

This electric locomotive is used on railroads among the Rocky Mountains. Have you seen other kinds?

When we see a giant steam locomotive on one track, and an electric engine near-by, we feel quite sure that the first would win any test of strength. Not long ago a railroad decided to find out which kind of

engine is really more powerful. The two could not be set to pulling against each other, for the coupling between them would be sure to break and perhaps something else would, too. So a pushing contest was arranged.

Two big steam engines were coupled together, and the front end of one was placed against the front of an electric locomotive. The two engineers were told to open their throttles wide. This means that they gave their engines the full power of the steam that had been raised. The motorman was told not to turn his electric current on just yet. There was a long stretch of track, and with nothing to stop them the two steam giants were soon pushing the other locomotive along almost as fast as an express train. Then a signal was given, and the motorman of the electric locomotive turned on his power.

The speed of the engines at once became slower. Black smoke spouted from the smokestacks, showing how hard the steam engines were working. But no matter how much they puffed, they could not go fast again. It was as if they were dragging a long, heavy train up a steep slope. The two did their best, but in spite of it they kept losing speed. Finally, even though their throttles were still wide open, they were forced to a dead stop.

This lasted only an instant. The steam locomotives kept pushing with every bit of strength they had, but their wheels began to slip on the rails so that they found themselves sliding backward. The power of the one electric locomotive proved greater than that of the two steam engines combined.

The Pennsylvania Railroad uses many electric locomotives, so that their trains may run as quietly as possible. Steam engines would make a great deal of smoke and noise. All the way from New Haven, Connecticut, to New York City, and again from New York to Washington, D.C., there are overhead trolley wires to carry electricity to the trains. No steam locomotive is allowed to enter the city limits of New York. That is the reason why an electric locomotive drew our train when we left the Grand Central Terminal.

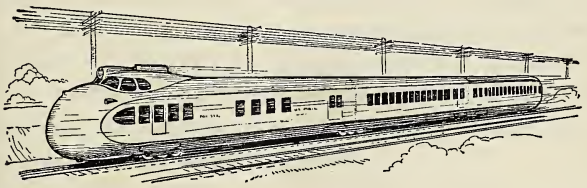
In the central part of the country, the Chicago, Milwaukee and St. Paul Railway runs electric trains over long distances. In this way coal is saved, and passengers travel more comfortably because there is no smoke. Also there is no danger of setting forest fires because no blazing cinders are puffed out by the engine. In the South, the Virginian Railway runs electric trains over many miles of track.

The United States has in all a little over three thousand miles of railroad where the trains are run by electricity. There are more than one hundred and twenty times as many miles where steam is used. Is there any railroad near your home where electricity is used? Do the locomotives receive their current from an overhead trolley, or is the railroad you know one of the few where a third rail can be used?

In some places another kind of locomotive that does not use steam power is coming into use. We may have been surprised, while waiting at a station on some branch line of a railroad, to see a single small car coming along the track without any engine. We

were expecting a train, because we had heard the warning whistle, and a ding-dong or two from a small bell. Instead here came what looked like a street car, except that it had no trolley. We were puzzled because we knew that there was no third rail for electricity on this line.

The car pulled into the station with a whir like a motor truck. A few passengers got aboard. Something inside the car started up, sounding for a moment like the pump of a fire engine. Then the little car sped quietly away. You have now probably guessed that it had a motor like the one in an automobile truck, and that it used gasoline for fuel. It seems a very sensible idea to run cars like this on lines where there are few passengers, for of course each trip costs the railroad much less than a train would.



A stream-lined train.

At present experiments are being made with a three car train, with power from an oil-burning motor. It is stream-lined like the fastest racing automobiles and is expected to run about 110 miles an hour. The Union Pacific Railroad, the Burlington Route, and the Boston and Maine Railroad all have trains of this kind. The first car contains the engine, a railway post office and space for baggage. The other two cars seat sixty

passengers each. The rear one has a buffet for serving meals to passengers in their seats.

The cars on these trains are not nearly as tall as old-fashioned cars. They are built of aluminum. All three of them together weigh only a little more than a single one of the usual kind of Pullman car. Thus the trains can run at lower cost because they use less fuel. They can also run much faster than steam trains. If these trains are successful, there will probably be larger ones made up of aluminum sleeping cars.

The New York Central Railroad is experimenting with a new stream-lined steam locomotive. This engine and its tender are covered with a huge curved shield, which encloses practically everything except the wheels. The smoke stack, the bell, the whistle, and all other parts that usually show along the top are hidden. By this means wind resistance is lessened and speed is increased. Also, fuel is saved.

Except when it is backing a train out of a railroad terminal at the end of a journey, the natural way for a locomotive to run, of course, is with its front end ahead. This is so that the engineer can see the track without having to look over his shoulder. Have you ever wondered how the locomotive, after being taken from the forward end of a train that has just come into the terminal, is turned around so that it can be attached to the forward end of an outgoing train? This, of course, cannot be done on one of the regular tracks. To be turned around, a locomotive has to go either to a special switch or to the roundhouse.

Every railroad yard has a roundhouse in which the

engines are put, like horses in a stable, when they are through with their day's work. They are oiled and repaired there, too. The building is called a roundhouse because its walls, instead of being built around the sides of a square, form almost a complete circle.

At the entrance to the roundhouse is a turntable. This looks like the top of a big round table, and has a track running across the center. It can be turned to join any of the tracks that run from the yard to the roundhouse. Inside the roundhouse are many short tracks arranged like the spokes of a wheel. As each engine comes from the yard, it runs on to the turntable. Machinery turns it until its track joins the one leading into the stall belonging to this locomotive. Then the locomotive backs in. When it is time for it to be coupled to another train, the locomotive runs out on the turntable again and is switched to the right track. Then it backs down to its train and is coupled to the front end of it. Coupled is the word railroad men use when the engine or the cars of a train are fastened together.

WHAT TO READ

Boys' Book of Railroads. Irving Crump.

Tells about the everyday work of engineers, conductors, firemen, the crews of freight trains, and the men who work in the roundhouses and railroad yards.

Engineering Feats. Archibald Williams.

Chapter XXV. The Iron Horse.

The Iron Horse. Nathan and Ernst.

Thirty-seven pictures beginning with the Indian travois and ending with a modern oil-burning Mallet locomotive.

FREIGHT TRAINS AND MAIL CARS

In a freight yard — Traveling ice boxes — How cattle travel — Freight cars wander far from home — The brakemen and their caboose — What is "fast freight"? — What would happen if there were no freight cars? — How railroads carry the mail — A peep into a mail car — Dropping the mail and picking it up.

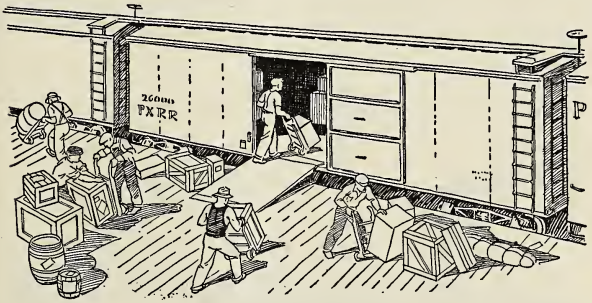
LOCOMOTIVES are kept under cover in the roundhouse at night, but most passenger cars and all freight cars are left out-of-doors. No railroad could roof over all the space occupied by all the cars. Out beyond the railroad station of any city, we find a place full of tracks where long lines of freight cars stand, waiting to be loaded or unloaded. There are so many cars that we wonder how they can ever be sorted out, or made up into trains. Busy little shifting engines are puffing about, moving a few cars at a time from one place to another.

A switching engine looks very tiny alongside the huge Mogul or Mallet locomotives. We notice that it has only three wheels on a side, and that they are all driving wheels. They are placed under the middle of the engine, and this makes it easy to start or to stop quickly.

Presently we hear some one say, "There is the hump, right over there." At first we are a little puzzled to guess what the hump is. We discover that it is the mound, or little hill with rather steep sides, which is used in switching freight cars. An engine pushes the cars up one side of the hump and lets them roll down the other side by their own weight. At the foot, switches lead to many different tracks.

Over one or another of these tracks each car is then taken to its own unloading platform, and when it has been emptied, it is moved to another part of the yard until it is wanted for loading again.

We have perhaps thought of freight cars as not especially interesting. There seem to be only three or four kinds, and they all look much alike. For example, we know flat cars when we see them. They are merely platforms on wheels. They have no sides and no roof, and are used for carrying lumber, steel beams for buildings, machinery, and other heavy, clumsy loads that could not be put into a covered car.

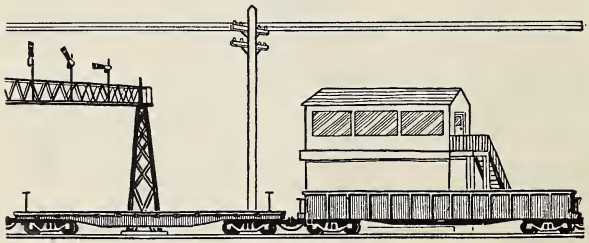


Loading a box car.

We know box cars, too, for there are hundreds of them in any freight yard. They are just what anyone would guess from their name — big steel or wooden boxes. There is a sliding door in the middle of each side through which the car is loaded with all sorts of things that must be protected from the weather. Box cars, for example, may be filled with

crates of furniture, or with cases containing clothing, boots and shoes, or any of the articles sold in department stores. The paper and ink for printing books and newspapers are other things that box cars bring to the city. Often, too, they are loaded with leather for shoe factories or with bags of wool or bales of cotton for the mills where cloth is made. Can you think of other things they carry?

Perhaps some of us know a gondola car by sight. Those who do not will be disappointed if they expect to see anything like the graceful little boats used in Venice. This name is given this kind of freight car, perhaps, because years ago there used to be on American rivers big, open, flat-bottomed boats, called gondolas.

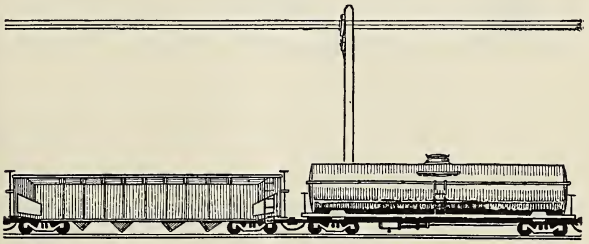


A flat car, and a gondola car.

A gondola car is halfway between a flat car and a box car. It has sides, but no roof, and is used for hauling coal, sand, iron ore, and other cargoes that are not damaged by weather. When it is unloaded, the sides are let down, and the cargo is shoveled out.

A hopper car looks something like a gondola car, but it has higher sides. The picture shows one. The three-sided things pointing down toward the track have doors which can be opened to let the load slide out by its own weight. This is done after the car has been pulled up on an elevated track below which are pits to catch the coal, iron ore, or sand with which the car is loaded. You can see how this saves time.

Tank cars are a kind that everyone can name at a glance. They could not well be named anything else, for they seem hardly more than big round tanks laid on their sides on platform cars. On top is a hatch through which they are pumped full of gasoline, oil, or some other liquid cargo.

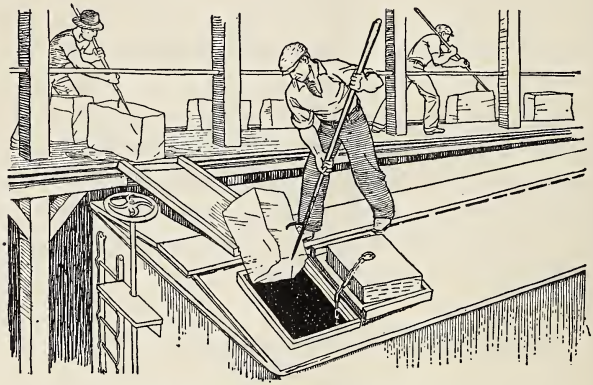


A hopper car, and a tank car.

So far we have a list of four kinds of freight cars, those most often seen in a railroad yard. There are several other kinds, used in special ways, that we shall be able to point out if we watch for certain things.

A refrigerator car looks very much like an ordinary

box car except that it is often painted yellow. Also, instead of bearing the name of a railroad, it may be marked Fruit Growers' Express, Merchants' Despatch, American Railway Express, or with the name of some other company that owns refrigerator cars.



Packing ice into a refrigerator car.

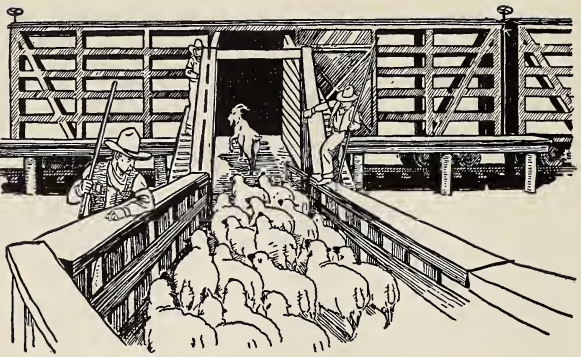
Such a car is really a traveling ice box. It has double walls and double doors to keep out the heat, and inside its roof are spaces filled with ice. Refrigerator cars are used by the great meat-packing houses in Chicago, Kansas City, and other places. The fruit growers in California and the South use them also, and so do the companies that ship bananas all over the country. Fresh meat, milk, and vegetables also can be carried in refrigerator cars for long distances without spoiling.

Have you ever seen one of the new-fashioned cars for carrying milk? Outside it looks much like an

ordinary box car, although some companies paint their cars white. Inside are two big steel tanks, lined with glass, which, like huge thermos bottles, keep the milk at just the right temperature. These cars carry three times as much milk as a regular refrigerator car loaded with cans. They are easier and quicker to unload, because the milk can be pumped out, while cans have to be lifted out one by one.

Sometimes cows, and other farm animals too, travel by railroad. If you see a car whose sides are built of boards with rather wide spaces between, you will know that it is used for hauling live stock. The openings let in fresh air. Inside are troughs for water and food, so most animals can stay in the car until they reach the end of their journey. Cows usually stand facing across the car. One has her head facing one side of the car, and the next one faces the other side. In this way the car holds more cows, and each animal helps the ones beside her from being jolted off their feet.

You would be interested if you could watch the loading of sheep into a car. A fenced-in runway leads up to the door, and the men start driving the flock aboard. What do you suppose they have to help them? You know, perhaps, that sheep are harder to drive than cows. If they once get started, however, one follows another readily enough. So the men put a goat at the head of the procession. He seems to understand better than any of the sheep what the men want him to do. He marches straight into the car, and the sheep crowd along behind him.



Loading sheep into a stock car.

You can imagine how very helpful this goat is when we tell you that sheep have to be taken out of their car to be fed. They are therefore loaded and unloaded a number of times during their journey. If the men had no goat to act as a leader, they might spend many hours chasing their sheep about in their effort to get them back into the cars. The cars in which sheep are carried are double-decked; that is, they have two floors, one above the other. The sheep are loaded into both. Cars that carry hens have four floors.

Each railroad marks the cars in some special way, so that anyone can tell to whom they belong. There are cars painted a dull red, others a bright blue, and some are yellow or brown. Other colors are used too. Each car bears the name of the railroad to which it belongs and sometimes there is a shield, a circle, a triangle, or a row of stripes in different colors that can be seen a long distance off. Each

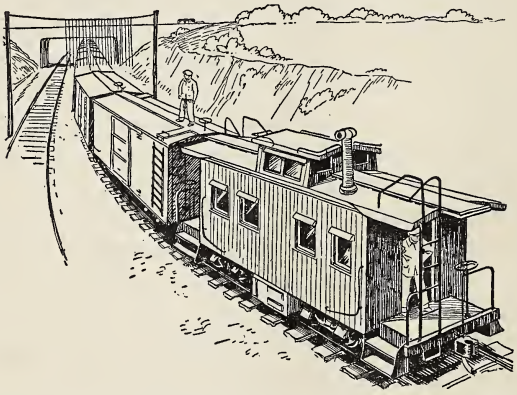
car has its own number, too, and each is marked to show how long it is, how high, how heavy, and how much weight it can carry.

All railroads have men known as car tracers. It is their work always to know where the cars belonging to their own railroad are. You often see cars that are a long way from home. They were loaded, perhaps, in Denver, Colorado, with something to be carried to Boston, Massachusetts. They started off over the tracks of one railroad, and passed over tracks belonging to several other roads before they came to the end of their journey. It would have cost too much money to unload the car somewhere along the way, put its cargo into another car, and then send the first one back to Denver. So once a car starts from one city to another, no matter how far apart they may be, it keeps on going. By and by, it will find its way back, loaded again with what someone wants to send to that part of the country. A story is told about one freight car that spent seven years traveling around before it finally was sent home.

How would you like to walk along the top of a freight train, while it rattled along around curves, under bridges, and through tunnels? Along the top of every covered freight car runs a narrow plank walk on which the brakemen have to go from one end of the train to the other. They must watch to see that no couplings between the cars break, that no tramps climb aboard to steal rides, and so on. On freight cars that have no air brakes, they must set the brakes by hand when the train is to stop. They have other duties, too. Perhaps you can get

acquainted with a brakeman who will tell you more about the work.

You may have noticed, just outside a tunnel or a bridge, a row of wires hanging from a line stretched across the tracks. These are long enough to touch the shoulders of a man standing on the top of a freight car, and they tap him gently as he passes by. This warns him "Low bridge!" so he can duck out of harm's way.



The little caboose at the end of a freight train. Notice the "low bridge" signal.

When the brakemen are not busy on the top of the cars, they go to the rear end of the train, climb down an iron ladder, and step into the car known as the caboose. This is the last car on any freight train. You can tell it by the little cabin, or cupola, on top. Here the conductor can sit and look out in any direction. Inside the caboose are benches

for the crew, and a table where the conductor works with his waybills. These are slips of paper that tell what the cargo of each car is, where it comes from, and where it is going. The conductor has to keep track of all his cars, and whenever the train comes to a station along the way where any car is to be left, he and his crew have a busy time cutting out the car, and then coupling the others together again.

The caboose is really both the office of a freight train and the living quarters of the crew. You can see how important it is in the everyday work of the railroad.

If you ever visit a town in Pennsylvania named Susquehanna, go to the Erie Railroad Station. Near-by you will find a little red caboose which once went on a sea voyage and spent a winter near the North Pole. Admiral Peary took it on one of his trips, and he and his men found it a warmer and more comfortable home than the snow houses of the Eskimos would have been. An interesting story about this little car has been written by Admiral Peary's daughter. It is named "The Red Caboose," and tells something about the everyday work of a caboose, as well as about the strange adventures of this one in particular.

There are two kinds of freight trains, "fast" and "ordinary." The first are made up of cars carrying food or some other cargo that has to be rushed through. They travel on a regular time-table just as passenger trains do. Most of their journeys are made at night, because the trains cannot start until

the freight houses close in the late afternoon. The fastest ones go forty miles an hour.

Ordinary freight trains carry things that are not needed in so much of a hurry. They are the ones that you often see during the day waiting on a side track until your passenger train has gone by. Then the freight train follows you along on the same track until it has to turn out and wait for another passenger train to pass.

We have learned some of the most interesting things about freight cars. If we never thought of it before, perhaps we now realize that the world would be a very different place if there were no cars of this sort. In every city there would probably be grassy plots for cows to graze on, since there would be no trains to bring our morning milk from distant farms. Other parts of the city would be turned into orchards and market gardens, for our fruits and vegetables would have to be grown near home. The seasons when we could have these fruits and vegetables would be short, for in most parts of the country they could not be grown in winter.

Our fathers would perhaps have to raise their own wheat and grind it into corn, just as George Washington did at Mount Vernon. Our mothers might have to weave the cloth for our suits and dresses, as women did in colonial times, because there would be no cars to take wool or cotton to mills, and none to bring clothing from factories. New houses would be built from wood cut in the nearest forests. There would be no coal for our furnaces. In these ways and in others that you can think of we might find

ourselves living much as people did more than a hundred years ago.

But, you may say, we should still have motor trucks. We must remember, however, that a motor truck can carry only a small part of the load of a freight car. It would take millions of them to supply every part of the country with all the things the people need day by day. Then, too, there are some things that motor trucks never could carry at all. Besides, while motor trucks are useful in moving goods for short distances, they would not work so well if they had to travel long distances like freight trains.

We have learned how passengers are speeded on their journeys, and how fast freight is rushed back and forth through the country. The railroads carry something else that is important to everyone. This is the mail. Trains that carry mail are almost always given the right of way over other trains. Often an express train with mail cars attached travels a mile or more a minute.

Let us see how letters are sorted and how bags of letters are dropped off and others picked up while these trains are traveling at their highest speed.

If you have never looked through the door of a car marked "United States Mail" you have missed something worth seeing. The next time you board a train at some terminal station, take a few minutes before your train leaves to walk down the platform as far as the car next to the locomotive. This is the mail car's usual place in a train. The doors will probably be open, so you can get a good view of what is going on inside.

A mail car is really a small traveling post office. Bags of mail are brought to the doors right up to the time when the train starts. The clerks take these bags in, open them and set to work sorting the letters, newspapers, and parcels as fast as their fingers can work.

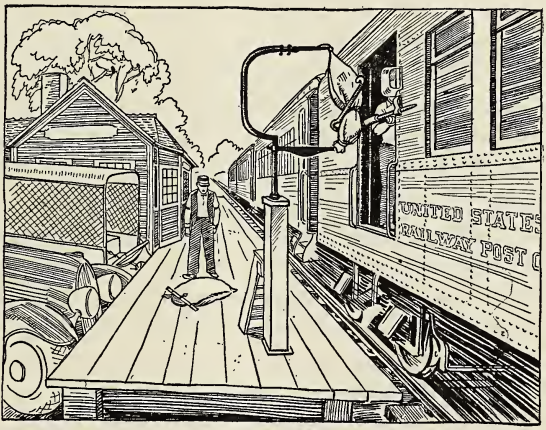
At the end of the car is a table for First-Class Mail. Above it, along the wall, are rows of open boxes or pigeonholes, each marked with the name of a town. A man stands here with a batch of letters and postal cards, slipping them one by one into the boxes. He seems hardly to glance at the written addresses, yet faster than you can read about it, he sorts out one handful and takes another.

At a near-by table a second man is clicking away with a machine, canceling the stamps on letters and packages that have been posted in the mail boxes in the station instead of on a street corner.

Through the center of the car runs a long, narrow aisle. On each side is a row of racks from which hang a hundred or more big canvas bags, with wide open mouths. Back and forth, but never getting in each other's way, move two men, tossing newspapers and small packages into one or another of the many bags. They do not seem to aim any of their throws, yet they almost never miss their target. Even if, for instance, the bag labeled "Franklin" is ten feet away, every newspaper addressed to a person living in that city goes plopping straight into that bag — and not into the one beside it.

The men in a mail car have to keep up with their work, and they must do so without making mistakes.

Their train will stop at many stations to leave mail. Some minutes before the train pulls in, therefore, the bags for each place must be ready to drop off. Other bags of mail for places farther along the line are taken on at nearly every stop. So all the way to the end of the run there is plenty for the clerks to do.



How an express train picks up a mail bag.

Sometimes a train has mail to leave at a station where it does not stop, and sometimes it must pick mail up without stopping. Perhaps you have stood on the railroad platform in some small town when a mail train has gone thundering by. You may have seen a sack or two of mail tossed from a car, and watched them turn somersaults in a cloud of dust beside the track until the station master ran and picked them up.

Have you ever seen a mail bag taken on by a train

which does not slow up? This is the way it is done. Close to the track is a strong post of wood or iron with two arms near the top, one above the other. These are just far enough apart to hold a mail bag between them, and they reach out toward the track. When a mail train is due, the bag of mail is hooked, top and bottom, to these two arms. A clerk on the train swings out a thing that looks like a big iron hairpin, with the open end toward the front of the train. With this he pulls the mail bag from the hooks and swings it back through the car's open door. Then the bag is emptied, and the men set to work sorting the letters and newspapers.

When the train gets to the end of the run, the mail bags that belong to that city or town are given to the drivers of mail trucks who are waiting to receive them. They rush them to the post office, where other clerks sort the mail again according to street addresses and give it out to the carriers who deliver it at the doors.

All along the line, at every hour of the night and day, faithful men are working to deliver your letters just as speedily as it can be done.

WHAT TO READ

How They Carried the Goods. C. G. Muller.
Chapter XIII. When the Hurricane Swept Miami.

Clear Track Ahead! H. B. Lent.
Stories about freight trains and a passenger express.

How They Carried the Mail. Joseph Walker.
Chapter XIV. The Fast Mail.

Transportation. W. F. Rocheleau.
Chapters IX. Carrying the Mails; VIII. Express.

SAFETY ALWAYS

The semaphore — The block system of signals — Who works the signals? — Stopping a train — What the whistling means — Don't play on the tracks!

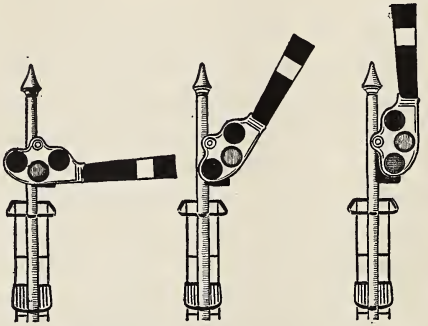
NOW we come to the story of some of the things that railroads do to keep their trains running safely. Most railroads have a motto, "Safety Always," and nowadays bad accidents do not happen very often.

The engineer of a train must always be sure that he has a clear track ahead. He knows whether he has or not by watching the semaphores, or the colored signals along the way. A semaphore is a tall post with arms near the top which can be set in three ways. When the arms point straight up, it means that the track is clear, "Go ahead." When they are level, and pointing straight out at the side, it means that there is another train close ahead. The engineer must stop. If the arms slope upward, halfway between straight up and straight out to the side, the train may go ahead slowly. The engineer must watch carefully to see what the next signal will be.

The arms of the semaphore have round openings covered with colored glass, green, red, or yellow, through which the daylight shines. Only one color shows at a time. Green means that the track is clear, red that it is not clear, and yellow that the train may go ahead, but not at full speed. At night there are lamps with these same three colors, so that the signals are always clearly shown to the engineer.

Sometimes a row of lights is used for signals both by daytime and at night. If you see two or more

red or yellow lights in a straight line pointing across the track, it means "Stop." If the lights are green or yellow in an up-and-down line, they mean "The track is clear." If they are yellow and in a slanting line, they mean "Caution. Go slowly." The whole plan is somewhat similar to that of the lights used to regulate motor traffic on city streets.



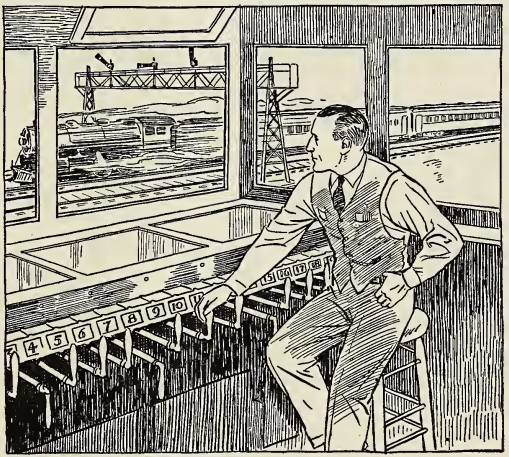
Can you read these semaphore signals?

Perhaps you have heard someone speak of the block system of railroad signals. This means that at every little distance along the track there is one of these signals. The space between them is called a block. These signals work in such a way that when there is a train in any block, they say either "Stop" or "Go slowly" to the train next behind. When the first train gets to the end of the block, the signal changes to "Go ahead."

Sometime when you are at a way station, which is the name for any station not at the end of the line, watch to see the signals change. When a train pulls

in, you will see a green light beside the track. This changes to red just as the train runs by it, and a moment later when the train has almost reached the end of the block, some distance away, it changes to yellow. Finally a green light shows again.

Signals along the tracks between way stations are worked by the trains themselves. Electric wires connect them with the rails, and the wheels of the passing trains turn the electricity on or off so that the signals change.



Inside a signal tower.

Near cities, there are towers every two miles or so apart. Men in these control the signals, working them by electricity. In the railroad yards outside the great terminal stations, there is one central tower. Here watchful men move electric levers

which open or close switches and which set signals that show all trains whether or not they have a clear track. Accidents almost never happen. This is because the levers are so made that when the "Go ahead" signal is shown to a train on one track, it cannot be shown to a train on any other track that joins or crosses the first one.

The man in charge of a signal tower is a train dispatcher. He knows at all times exactly where every train is on the tracks that he controls. He telegraphs ahead to the next tower whenever a train moves out from his own yard. To help him, there is in front of him a large board that shows all the tracks. Lights of different colors tell how all the signals are set and the direction in which each train is going.

All passenger trains and nearly all freight trains are stopped by air brakes, worked by a valve in the cab of the locomotive. In the old days a man on each car set its brakes separately by a wheel turned by hand. For this reason he was known as the brakeman. This name has been kept for many of the helpers on the trains, although they hardly ever have to set the brakes. In modern trains a tube carrying compressed air runs from the engine all the way to the last car. As each stop signal or station is reached, the engineer sets the brakes on all the cars and lets them off again when he starts the train. You have probably heard the hissing noise made by the air in the tube when he does this. The engineer can stop even a freight train of a hundred cars more quickly and more smoothly than

a hundred men at the hand wheels of the cars could do it.

Once in a great while, you may hear of a railroad accident that happened because a train ran past a signal. Perhaps it was in thick fog or heavy rain or snow, when the engineer could not see. To guard against any chance of this, many locomotives have a special kind of brake which sets itself when the train reaches a stop signal. It works by electricity, the moment the wheels of the locomotive pass over the spot in the track at which the engineer ought to set his air brakes. Before the train can go ahead again, the engineer has to climb down from his cab and unlock the box that holds this special brake.

Do you know how the conductor of a passenger train sends signals to the engineer while the train is running? Perhaps you have noticed that through each car, near the ceiling, is a long cord. This reaches from one end of the train to the other. When the conductor pulls it, it sounds a little signal in the engineer's cab — twice, three times, or sometimes more. The engineer answers it by blowing his big steam whistle the same number of times.

For example, if you hear two blasts on the locomotive's whistle while the train is running, it means that the conductor has sent the signal "Stop." If there are three blasts, it means "Stop at the next station." Four means "Run slower"; five, "Run faster."

When a train stops between stations, the engineer blows two long and three short blasts. This is an order to a flagman to go back from the end of the

train. He is to warn any other train that may be following. He returns to his train when the engineer whistles four times, with long blasts.

Other signals when the train is standing still are: two whistles, "Go ahead"; three whistles, "Back up." You see that all these signals, although they make a lot of noise, are really a quick and sure way of sending and answering orders. They help to run the train in a safe way, to keep it on time, and to guard the comfort and the convenience of passengers.

There is another signal by whistle that you hear before a train comes to a small station where it is to stop. It is one long blast. It warns the station master and the baggage man and tells the passengers to get ready to board the train.

Sometimes, out in the country, you hear a signal that sounds like this: —— —— — —. The train is then coming to a place where a road crosses the track. This is a grade crossing. On some railroads there are still many such places where there are no overhead bridges for automobiles and other traffic.

Wherever they can, railroads are arranging their tracks so that there will be no grade crossings. Where it would not be a good plan to carry the road across the tracks on a bridge, the railroads make a cut under. This means that the road is lowered so that it passes under the tracks. Perhaps you have seen this same thing done where two busy automobile highways cross each other in or near a city.

Grade crossings all have signs reading "Railroad Crossing," or perhaps, "Stop, Look, and

Listen." To give people one more warning, however, the engineer always blows his whistle and rings his bell.

At grade crossings, automobiles should always look out for trains and be ready to stop when they see any signal that one is coming. Sometimes a man holds up a disk with the word "Stop" painted on it in large letters. Sometimes there are red lights that start swinging or blinking when the train is still some distance away. There may be a bell that starts ringing at the same time, and keeps on ringing until the train has passed.

In the busy parts of towns, grade crossings are shut off at train time by heavy gates that are lowered across the street. No one should ever start across after these gates begin to close. If there are double tracks, people should use double care. A second train may be coming from the opposite direction after the first one has passed.

The railroads do all they can to prevent accidents all the way along the line, and if people are hurt crossing the tracks, it is quite likely to be their own fault.

We can learn most about railroads by visiting stations and freight yards. We should be careful, however, always to do so when some older person is with us. Best of all, we should get a guide from the office of the railroad company. He will not only point out the things most worth seeing, but he will arrange our visit in a way that will be perfectly safe.

A railroad track is a dangerous place for anyone

to walk or play. People are often killed by trains that come along unexpectedly. Railroads warn everyone to stay off their tracks by posting signs, and by putting up fences and gates. Anyone who refuses to pay attention to these things runs a great risk of being hurt. Locomotives do not jump off the tracks to chase people, but if anyone gets in their way, he is sure to be hurt. "Safety First" is a good rule, but "Safety Always" is better.

WHAT TO READ

Clear Track Ahead! H. B. Lent.
Part One, Chapter V. "Clear Track!"

Transportation. W. F. Rocheleau.
Chapter V. Railways (Equipment and Management).

Travelers and Traveling. E. M. Tappan.
Chapter I. How Railroads are Built and Trains are Run.

RAILROADS THE WORLD OVER

How American railroads have grown — Linking the East and the West by rails — If all the cars in our country were made into one train — If all the tracks could be pieced together — How we compare with the rest of the world — The different railroad "gauges" — Something about trains in Europe — Three famous foreign railroads — Railroads and the work of the world.

YOU will remember that the first railroads in the United States had very few miles of track. A little more than a hundred years ago, someone suggested building a line about seventy-five miles in length. Such a plan was unheard of in those days. Most people believed the man was crazy. They said, "A railroad may be all right for a short distance, but there can never be one as long as seventy-five miles!"

A few thought differently. One man wrote a book in which he said: "The time will come when people will travel in stages moved by steam engines from one city to another, almost as fast as birds can fly. A carriage will set out from Washington in the morning, the passengers will breakfast in Baltimore, dine at Philadelphia, and have supper in New York the same day."

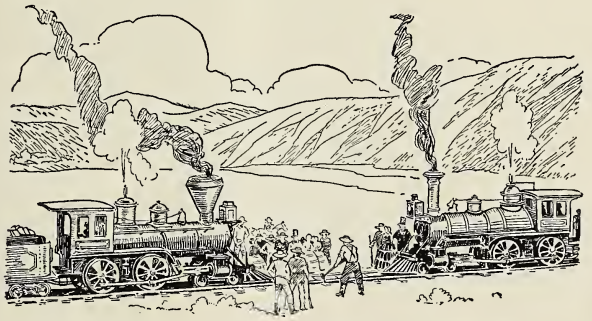
About the same time another man who thoroughly believed in railroads said, "In a few years you will be able to ride from the Gulf of Newfoundland to the Gulf of Mexico, from icebergs to orange groves in a few days." How surprised and pleased these people would be if they could travel on fast trains and make the long journeys that they foretold as easily as we can today!

Less than twenty years after the DeWitt Clinton train made its first run, railroads had been built between all the large cities in the eastern part of the country. The first line all the way across the continent was begun in 1862. One company, the Central Pacific, built its tracks eastward from Sacramento, California. Another, the Union Pacific, built westward, starting from Omaha, Nebraska, a city which was already connected with the East by railroad.

The route of the new line followed quite closely the trails made by the Indians, the fur traders, the miners, and the settlers who years before had gone to California in Conestoga wagons and stagecoaches. The Indians did not like to have rails laid across their lands, and often attacked the railroad builders. Part of the distance the tracks ran straight across level prairie where the work went ahead rapidly. Other stretches wound through mountain passes and crossed swift rivers. Many tunnels had to be cut through mountains. This kind of railroad building took a great deal of time.

At last, on May 10, 1869, the tracks of the two companies met near Ogden, Utah. One train came in from the west and another from the east. The two locomotives were very different from the ones we see. The Central Pacific engine had a big smokestack shaped like a bell upside down, while the Union Pacific engine had a tall, slender smokestack with straight sides. Each had only four small driving wheels. Ten locomotives the size of these would not have weighed as much as a single big Mallet type engine of our day. The two locomotives ran slowly

up to each other and touched noses, like two great friendly dogs. Bret Harte wrote a poem, "What the Engines Said," in memory of this meeting. Perhaps you would like to read it.



The first trans-continental railroad is completed.

There was a great celebration when the last tie was laid and the last spikes driven. The tie was a piece of California mahogany bound with silver. There were silver spikes from Nevada, Idaho, and Montana. Arizona sent a spike made of a mixture of gold, silver, and iron, and California sent two made of gold. Can you tell why these metals were chosen by these States?

There were speeches, music, and cheering. While the last spike of all was being driven, each blow of the hammer was signaled by telegraph to San Francisco, where a great bell was rung once for each blow. At the last one, a cannon was fired. Omaha, Chicago, New York, and Philadelphia were among the other large cities that celebrated in one way or another.

The building of this railroad was one of the great events in our history. Can you tell a few ways in which it helped our country to grow?

Up to this time there had been a railroad only as far west as St. Joseph, Missouri. That part of the journey across the continent could be made in three days. The rest of the way to California, travelers had to ride in stagecoaches and the trip took twenty-six days or more. The new railroad made it possible to go from the Atlantic to the Pacific in about a week.

To us that would seem slow traveling. Our trains make the run in about three days. Automobile busses, driving night and day, take five days. Regular passenger airplanes need only one day. Probably before many years a man in a hurry will think nothing of having breakfast in New York and dinner that evening in San Francisco.

Railroads are now by far the most important means of transportation in the United States. To get an idea of the number of cars and engines there are in our country, let us see how long a train they would make if it were possible to fasten them all together. Let us suppose that the locomotive at the head of such a train is at the very tip of the Cape of Good Hope, way down at the southern end of Africa. There are thousands of locomotives, passenger cars, and freight cars following along behind it, first to the Suez Canal, then across Asia to Bering Strait, then to Alaska, next down through Canada and the United States, past the Panama Canal, and finally along down South America almost to the tip of Cape Horn. If you draw straight lines on a map from each of

Railroads are important in transportation by land. What kinds of locomotives and cars do you see here? Are they all going on long journeys?

these points to the next one, they will, taken all together, represent an imaginary train nearly 20,500 miles long. The locomotives would fill 1000 miles, the passenger cars 700 miles, and the freight cars the rest. If we could count them all, we would find that there were 65,000 locomotives, 53,000 passenger cars, and almost 2,350,000 freight cars. Most people have little idea that there are so many more freight cars on our railroads than passenger cars.

Here is another interesting fact that shows the hugeness of our railroad business. If we measured all the miles of tracks in the United States, counting those in railroad yards as well as those along all the routes throughout the country, we should get a total of 429,000 miles. This means that more than seventeen lines of track could be laid completely around the earth at the Equator. Now, suppose that an express train running fifty miles an hour, like the Twentieth Century Limited, started at one end of these tracks. If it set out on New Year's Day, and kept going at full speed night and day, it would not get to the end of the last mile of track until two weeks before Thanksgiving.

If we count only the main railroad lines in our country, we find that they fill more than 250,000 miles. This is about one third of the total in the whole world. Next to the United States comes Russia, with 47,000 miles. After that the leading countries are Canada, with more than 40,000 miles, India with 38,000, Germany with 35,000, Australia with 27,000, France with 25,000, Argentina with 23,000, Great Britain and Brazil with 20,000 each,

and the different colonies in South Africa with about 12,000.

Most of the railroads of the world use tracks of the same width that we usually see in our country. The rails are four feet, eight and one half inches apart. This is standard gauge, and the reason why this particular width was chosen is rather interesting.

The first railroads, you remember, were built in England. The reason the English made their tracks the width they did is simply that the stagecoaches and carriages used before the days of railroads had their wheels just that far apart. The people who built the first railroad cars copied these stagecoaches, and the people who laid the tracks spaced them to fit the width between the wheels. Ever since then most of the railroads of Europe and of North America have followed this idea.

In South America, however, and in parts of Africa, Australia, India, and China there are narrow gauge railroads. This means that the tracks are three feet six inches, or less, wide. These tracks cost less to build, and they can be run around the sharp curves that often have to be made in hilly and mountainous country. There are a few in our own country. Do you know any? Do they use steam or electricity?

In Spain and in Russia wide gauge railroads are common. Their tracks are five feet or more in width. There is no good reason for building railroads as wide as this. You can see that there is one great disadvantage. Suppose some freight is put on a train on the Pacific coast of Siberia. While it can be carried a long, long distance westward without changing

cars, when it reaches the border of Germany it must be loaded into a standard gauge train. If part of the freight is going into Spain, when it reaches the border of that country, it has to be moved again into broad gauge cars. Of course this adds to the cost of carrying it, and so makes the price higher when the goods get to the end of their journey.

When we travel in Europe, we find the trains different in many ways from those at home. Most of the locomotives are smaller than ours, and so are the cars. Three of their passenger cars would be about as long as two of ours.

The trains run more quietly, partly because the engines do less whistling and because they have no bells to ring. There are few grade crossings, and whenever a road does cross the track, it is closed by a gate when the train passes. A man lives in a little house beside the crossing, and it is his duty to see that the gates are closed before a train is due. The noisy warnings of whistle and bell that our engines give are not needed.

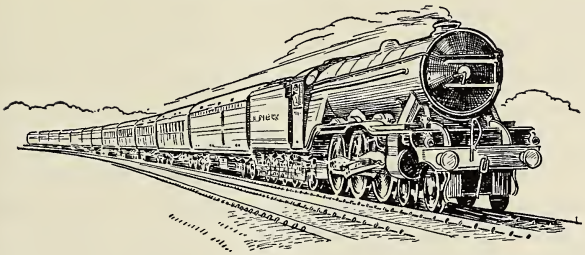
The cars have larger wheels than ours, so they stand higher above the rails. Station platforms are built on a level with the doors of the cars, so when you enter or leave a train there are no steps to climb. Instead of an aisle through the middle of a car, there is usually a narrow one along the side. There are "compartments" with two seats, facing each other, each wide enough for either three or four people. A little sliding door shuts the compartment off from the aisle. Opposite this door is another one in the side of the car, which is locked whenever the train leaves

a station. When the train reaches the next station, men known as guards hurry along the platform and open the door of each compartment, so that people can get in or out.

The first two or three times we ride in a foreign train, we shall be much amused by the funny little tin whistle the conductor blows to signal "Go ahead" to the engineer. The steam whistle with which the engineer answers sounds strange, too, for it makes only a very gentle toot.

In nearly all the countries of Europe the cars, or carriages, as they are called, are grouped into several classes, first, second, or third. First-class carriages are the best built and the most comfortable. If we were going to take an all-day trip, we should perhaps choose seats in a first-class carriage, just as at home we might engage seats in a Pullman. On shorter rides, we should no doubt travel second-class, for this carriage would be quite as comfortable as our ordinary day coaches in America. We might not care to ride in a third-class car except in England or in Switzerland, since except in those countries these carriages are apt to be crowded and the seats are hard.

Of all the locomotives abroad, we shall probably think the English ones the finest. They are usually painted in bright colors, green, red, or blue, and have brass trimmings. Many of the pipes and rods that you see along the sides of American locomotives are covered over, so only a little machinery is in sight. The smokestack is wide and low, and when the engine is running you hear no puffing noise, but only a sort of quiet "click-click-click."



The Royal Scot, a famous English train. In the British Isles the rule of the road is, "Keep to the left."

In 1933 a famous English train named the Royal Scot, which runs between London and Edinburgh, was brought to the United States. It was shown at the Century of Progress Fair in Chicago. Before and after the Fair it made a tour of North America. Perhaps you saw it somewhere along the route.

We cannot single out any railroad and say that it is the most important and most wonderful in the world. We cannot say that any one of them is the most interesting. There are three, however, that have done so much to bring closer together people who used to be separated by deserts, by mountains or by forests, that we ought to know them at least by name. One of these is in Africa, one crosses a part of Europe and all of Asia, and the third is in South America.

Look on the map of Africa and find Cape Town. Then find Cairo, about 6000 miles north. One of the longest lines of railroad in the world is being built between these two places. Many miles are now in use, but the part across the Sahara Desert is not yet

ready. When the whole distance has been covered, the railroad will be about twice as long as the ones between New York and San Francisco. The journey from one end to the other will take about ten days. How long does it take for trains to cross our country?

Before the Cape-to-Cairo Railway was built, the usual way for travelers and merchants to reach many parts of Africa was by camel caravans. Travel of this sort was slow and dangerous. When this railroad is finished, it will connect with others running east and west. The products of nearly all parts of the continent can then be carried to the seaports on trains. This will mean a great deal to the people of Africa. It will also make it possible for more people from other lands to become acquainted with this part of the world. Africa used to be spoken of as "the dark continent" because so little was known about it. Thanks to railroads, however, the whole continent is being opened up, and the people who live there are being taught up-to-date ways of farming and manufacturing as well as better ways of traveling.

Another great railroad in another far-away land is the Trans-Siberian Railway, in Russia. It runs from Leningrad and Moscow to two important places on the Pacific Coast, Vladivostok and Port Arthur. It makes the journey from Europe to China or Japan many days shorter than it used to be. Years ago anyone who wished to go from Leningrad to Peiping needed forty-five days if he went by way of the Suez Canal and the Indian Ocean. If he went the other way, first crossing the Atlantic to America, then going by train from New York to San Francisco, and finally

taking another ship across the Pacific, the journey took thirty-five days.

Today the railroad carries travelers from Leningrad to Peiping in ten days. If the railroad had a double track, so that there was no waiting along the way for trains to pass, the trip could be made even more quickly.

In South America, also, there is a railroad that saves travelers a great deal of time. It is named Trans-Andean because it crosses the Andes Mountains. The line connects Valparaiso, Chile, with Buenos Aires in Argentina, and is about 900 miles long. The journey takes only thirty-six hours. Before the railroad was built, the easiest way for people to go from one of these places to the other was by sea. This meant a long voyage down one coast of South America, through the Strait of Magellan, and then up the other coast. Can you find out how many miles that is?

There are so many other interesting things to tell about these railroads and others all over the world that the story fills many big books. We give you here the titles of several in which you can read how railroads have been built in places where you would never believe it possible to lay a track. You can read how they help the people who live there and those who go there on their travels. You can also find pictures that show the kinds of locomotives and cars that are used in these foreign lands. The more you learn about railroads, the more you will realize how important they are in the work of the world.

WHAT TO READ

Engineering Feats. Archibald Williams.

Chapters II. The First Trans-continental Railway; VI. A Railway Through the Sea; XX. A Railway of the Far North.

Historic Railroads. R. S. Holland.

Railroads in England, North America, South America, Europe, Asia, Africa, the Far East and Australia.

"Iron Horses the World Over." E. C. May. *Travel Magazine*, vol. LIX, May, 1932.

"The Railways to Civilization." L. A. Downs. *Home Geographic Monthly*, vol. I, no. 5, May, 1931.

The Romance of Modern Locomotion. Archibald Williams.

Railroads in all parts of the world.

The World's Railways. G. G. Jackson.

There are large colored pictures of locomotives.

Highways and Their Vehicles

GOOD ROADS AND WHAT THEY DO

A road more than three thousand miles long — Other great highways — A journey on the Lincoln Highway — On the Dixie Highway — Why good roads are important — How roads are built — The roads of olden times — Early American trails and roads — The Cumberland Road — How bicycles helped road building — Who pays for our roads? — Something about our city streets — Why some countries have few good roads.

NEARLY all of us, probably, do most of our traveling over the road instead of by train. We make our short journeys day by day by automobiles, and once in a while we travel longer distances by railroad.

If we were going all the way across the United States, however, we could if we wished go by automobile. We could drive over the Lincoln Highway. This is a road for vehicles which begins just across the Hudson River from New York City, and ends in San Francisco. It follows the shortest and the easiest way across twelve States, and is 3331 miles long. If we add a branch road that runs off the main line to connect Denver, Colorado, with the highway, we find that the total mileage is 3466. It is the longest roadway in the world.

The Lincoln Highway was built little by little. One section was finished, then another, and finally all were joined together. In many cities and towns the name of the main street was changed to Lincoln

Highway. Markers of red, white, and blue were set up short distances apart, with signposts showing the distance to the next important town. Other signs warned drivers about crossroads, sharp turns, and steep hills, or told the speed at which automobiles were allowed to drive. Interesting markers were placed to point out the scenes of historic events and the locations of early day forts and settlements. Firm, wide pavements were laid, and the road was kept as level as possible everywhere. Strong bridges were built wherever they were needed.

Today there are a dozen or more great automobile highways built according to the same plan. Some run from east to west, and some from north to south. Perhaps you live near one of them. Find out which one is nearest your home, where it begins, where it ends, what cities lie along its route, and what States it crosses. Here are their names. Lee Highway, named for General Robert E. Lee; Dixie Highway; Old Spanish Trail; National Old Trails Road; Theodore Roosevelt International Highway; Pacific Highway; Atlantic Highway; Jackson Highway; Jefferson Highway; Gulf Highway; Yellowstone Trail; Old Oregon Trail; Victory Highway. Can you name others?

Often there is beautiful scenery along highways. In the East one of the most attractive rides is over the Mohawk Trail which crosses Massachusetts and runs into New York. Along the way are woods and mountains. In the West, Chuckanut Drive is famous. It is hewn from the solid rock of the cliffs overlooking Puget Sound. It is bordered by giant

trees, left standing just as they were when the old Indian trail ran beside them.

Let us imagine that we are taking a journey over the Lincoln Highway, and then one over the Dixie Highway. These two pass many places of great interest to boys and girls who are studying history. They go also to many cities worth knowing about because of the things manufactured there. Afterwards, if you wish to take another journey over another road nearer home, you can write your own story about what you see.

On the Lincoln Highway, if we set out from its eastern end, we pass first several of the spots where famous events early in our country's history took place. There is Trenton, New Jersey, where Washington won an important victory, and there is Philadelphia, where so many things happened in the days of the Revolutionary War. We go also to Gettysburg, the scene of the greatest battle in the Civil War. At Pittsburgh we remember the wars of the colonists against the French and Indians when we see the ruins of old Fort DuQuesne. We think also of the old stagecoach days when it used to take twenty days to ride from Philadelphia to Pittsburgh.

Out in the Middle West the Lincoln Highway follows the route taken by the early explorers when they forced their way through the forests of Indiana and Illinois. We remember Father Marquette, and in the busy streets of Chicago there is pointed out to us the place where he once had winter quarters.

Beyond the Mississippi River the Lincoln Highway runs where there used to be old Indian trails, and the

paths worn by the long lines of prairie schooners or covered wagons in which the pioneers made their slow journeys to the West. How differently we make our journeys, and how different the country is, with its cities, farms, ranches, and mines!

We enter Nebraska at Omaha, and part way across the State we come to a signpost which marks the center of our country from east to west. A hand pointing one way says, "1733 miles to San Francisco," and one pointing in the opposite direction says, "1733 miles to Boston." This reminds us how very wide our country is.

We can trace our course westward on the map if we mark a line from Omaha through Cheyenne, Salt Lake City, and Carson City. At last we reach San Francisco. There in Golden Gate Park, near the entrance to the harbor, we see a famous statue, named The End of the Trail. It shows an Indian on horseback, with both man and beast completely tired out. Once again we think how hard the journey across the plains and through the mountains must have been when men first traveled through our Western States.

Now let us see what the Dixie Highway has to show us. It extends from Mackinaw in Michigan to Miami in Florida. If we start at the southern end, we see first some of the country's most famous winter resorts. Then at St. Augustine we find the ruins of the old fort built by the Spaniards more than three hundred and fifty years ago. We go northward through Georgia and Tennessee, passing some of the battle fields of the Civil War.

In Kentucky we are only a little way from the farm

where Abraham Lincoln was born. A national shrine has been built around the tiny cabin which was Lincoln's first home.

All the way from Chattanooga to the northern end of the Dixie Highway, there are two roads. We can choose which one to take. The eastern road goes through Knoxville, Cincinnati, Dayton, Toledo, and Detroit, and the western one through Nashville, Louisville, Indianapolis, and Grand Rapids. All of these cities, as you know, are famous for their manufactures. Can you tell which ones make automobiles? Whichever route we follow, it will before long bring us to the Lincoln Highway, for one branch of the Dixie Highway crosses it in Ohio, and the other branch in Indiana. There is also a third short branch running from Indianapolis to Chicago. This one meets the Lincoln Highway in Illinois.

People who travel over the Dixie Highway learn more about the country that they pass through than they could possibly learn by looking out of the windows of a railroad car. The road is doing a great deal to add to friendliness between the people of the North and the South, because it gives visitors from each part of the country a better chance to know each other than they could have if they traveled by train.

If you do not live close to any of the great national highways, you doubtless live near some other fine automobile road, for our country is now covered by a network of them. All the main roads are connected by shorter crossroads, so that all our people can easily travel from their farms and village to near-by

cities and towns, or from their city homes out into the country.

As you watch the traffic on any of these roads, what kind passes from day to day? What do the vehicles carry? Where do they take it? What do they bring back?

How many ways there are in which good roads help any neighborhood! In the old days when there were only rough dirt roads, people who lived in the country found it hard to visit their neighbors. Sometimes their carriages got stuck in the mud, and when the horses tried to pull them out, they often broke their harnesses. Farmers found it slow work hauling their crops to market. In stormy weather children hated to walk to school, and their fathers and mothers often stayed at home instead of going to church or entertainments. Automobiles, trucks, and school busses have changed all this. Travel in our country districts is now easy. The neighbors know each other and are able to have pleasant times together. The rural free delivery of mail is more prompt now that the postman can drive over good roads. What other advantages can you think of?

Do you know how modern roads are built? Probably you have seen steam shovels digging out a roadbed, steam rollers puffing back and forth, concrete mixers turning like a giant's ice-cream freezer, and motor trucks dumping crushed stone or concrete on a new roadway. You have probably been told that some roads are macadam and some are concrete. These are the two kinds that we are most likely to ride on as we take our automobile trips through the

country. Do you know the difference between them?

A macadam road is named for the man who first thought of building roads with crushed stone. This was at about the same time as our Revolutionary War. In building this sort of road, the first thing to do is to dig into the ground six or eight inches and scrape and roll the roadbed until it is level and smooth. Then the road builders spread the crushed stone, making one layer at a time. For the lowest layer, they use rather large pieces. Macadam's own plan, it is said, was to measure each piece by passing it through an iron ring about three inches across. If it would not go through, the piece was thought too big to use. The reason for choosing stone of a certain size is that if the pieces are too large, they will not fit tightly together when pressed into the roadbed.

After the first layer has been put in place, a steam roller goes over it, back and forth, until it makes a solid foundation. Then a second layer of crushed stone is laid. These pieces are about the size of an English walnut. The steam roller sets to work again, until this layer is packed hard. Next comes a layer of still smaller stone, which is rolled until the pieces are forced into any spaces there may be in the layer below. By this time the road looks smooth, but it must be smoother still. So a top layer of stone dust is spread and sprinkled thoroughly with a special cement of asphalt or tar. This is called the binder, because when it is rolled, the stone dust and cement are forced down into the lower layers and bind them together. The binder used on the first macadam

roads was nothing but water mixed with stone dust, for asphalt was not then known. Today this old-fashioned binder is sometimes used when the road builders wish to do their work in the cheapest way.

Macadam roads are not very expensive to build, but if the travel is heavy, they need to have new surfaces quite often. To keep them from getting dusty and to protect the surface, these roads are sprinkled once or twice a year with a special kind of oil.

Concrete roads are as hard as a rock, and will stand much more wear than macadam roads. They cost more to build, but less to keep in repair. After the roadbed has been prepared, the men who are to build a concrete road first lay their forms, in which the concrete is to be spread. These are like trolley rails, one along each side of the road. Every fifteen feet or so, there is a steel rod running across from one rail to the other. These prevent the rails from spreading. Another way is to connect them by strong wire netting.

Concrete is made by mixing sand, gravel, and the fine gray powder named Portland cement with the right amount of water. The concrete mixer is a big round tank shaped like a funnel at one end. It works by machinery, stirring together all the different things that go into the concrete until the mixture is about as thick as your breakfast oatmeal. Then the concrete is poured out on the roadbed where it is spread to the right thickness and allowed to dry.

It takes a concrete road several days to dry.

Until it is solid enough for automobiles, it is covered with straw or burlap. Very likely you have seen a road where one side was finished, and had cars spinning along on it, while the other side was still too soft to carry traffic.

We can usually tell a concrete road by the little groove running lengthwise along the middle, and the other grooves about fifteen feet apart running across it in straight lines. These are made to keep the frost from cracking the surface when it comes out of the ground in the spring. Cracks would be likely to come if there were no grooves, but these allow the cement to expand as the weather grows warmer.

Sometimes instead of a plain surface, a concrete road has one that looks like a crazy quilt made of broken stone. The pieces are all of very nearly the same size and are cemented together. These roads do not look quite so smooth to ride over as those made of plain concrete, but in a car we never notice any difference. One advantage is that in wet weather they do not get slippery. The name for this kind of road is bituminous concrete.

All automobile roads, both macadam and concrete, curve up a little at the middle and down at the edges, so that in rain storms, the water will drain off easily. Shaping the road in this way is called crowning it.

All great nations, ancient and modern, have understood how important it is to have good roads. Perhaps the first people in the history of the world who built roads were the Egyptians, just as they may have been the first to build ships. The people of Carthage,

an ancient city in the northern part of Africa, also understood road building. The best ancient roads were those built by the Romans all through their empire. The men who built them may have learned from the Carthaginians.

This is the way the Romans made their roads. You will see that it is not very different from the ways in which some roads are built today. First they dug a shallow trench on each side of the road to mark its width. Sometimes a road was fifteen feet wide, and sometimes it was only eight feet. Then the ground between the trenches was dug out until a firm foundation was reached. If the land was marshy, wooden piles were driven into it. After the foundation was ready, the road was built up in several layers. The first was of stones, none of which was smaller than a baseball. Above that, broken stones and lime were spread. This was well rammed down. Next came a thinner layer of broken bricks and pottery, cemented together with lime and packed solid. On top was laid a pavement of large blocks of the hardest stone that could be found. These blocks were nicely fitted together to make a smooth surface.

There were footpaths along each side of the road, raised a little above it, and strewn with gravel. Every little distance was a stone block to assist horsemen to mount. The chief highways had milestones marking the distance from the city of Rome.

All through Europe these roads ran, and through the northern part of Africa. There were some in the British Isles, too. Where the ground was level, most of them were quite straight, although they

wound in and out among high hills and mountains. They were so well built that in many places stretches of them can be found today.

The most famous of these Roman roads is the Appian Way, which you will probably see when you go to Italy. It was begun by a high officer named Appius Claudius more than eighteen hundred years before Columbus discovered America. When it was finished, it was about 350 miles long. This is the road along which the Apostle Paul passed when he traveled to Rome, as we read in the book in the Bible named The Acts of the Apostles. The Appian Way was kept in good repair for at least eight hundred years after it was begun, and even within recent times the old foundation was found strong enough to be used when a new pavement was laid. We wonder whether some of the great highways named in honor of our famous men will have as long a history as this old Roman road has had.

In ancient times China, too, had a fine system of roads. Many of them were broad and well paved with heavy slabs of stone. Up the steep mountain-sides climbed stone-paved stairways with treads so broad and steps so low that loaded mules could easily go up or down. These roads have nearly all gone to ruin because they were not regularly repaired. It is said that in China a road is good for seven years and then bad for four thousand. Another way in which Chinese roads are different from the Roman is their crookedness. Even on level ground there are a great many bends. There is a saying that they were built in this way so that travelers could dodge

evil spirits. The people believe that these demons always travel in straight lines and are so bothered by turns that they are likely to fly off the road and get lost.

The Chinese are beginning to see that their ancient roads are very much out of date. They are building macadam streets in their important cities, and modern automobile roads in many parts of their country. It will be a fine thing for China when more of these roads are built. They are needed not only for travel, but also for carrying goods to the railways. The ordinary roads of dirt and clay are of no use in the long wet season.

One of the wonders of the world is the ancient Inca Road, in South America, which was built more than one thousand years ago. It stretched about four thousand miles, from Quito in Ecuador to Tucuman in Chile. It runs through some of the roughest country in the world. It climbs mountains fifteen thousand feet high, and crosses canyons thousands of feet deep. There are bridges across roaring torrents, and tunnels through solid rock. In some places the road is built through vast sandy deserts, and in others across swamps. The Incas did not use wheeled vehicles, so the road was made for travel by men on foot and beasts of burden.

Many years ago there was another road parallel to this, nearer the coast. It is now almost wholly buried in sand. There are still many crossroads that were built to connect the two highways.

All the way along the main roads, the Incas had watch towers and places for signal fires or lights.

Messages could be sent long distances very quickly. Once, it is said, news of a revolt that had broken out near one end of the road was sent to the other end in only six hours. Goods were carried by runners, each of whom carried his load only ten miles or so and then gave it to a fresh man. One book tells us that fish caught in the Pacific could be carried three hundred miles over this road and be delivered at some inland city in six hours less time than it now takes the railroad to do the same thing.

Wherever the Inca road goes through a pass between the mountains, there is a huge pile of stones, called a cairn. These have been built up, one stone at a time, by the many travelers who have gone over the road. The idea was that when a man left a stone here he was making an offering to the spirit of the mountain. Then he would go on his way, feeling that this spirit would keep him safe and bring him to an inn where he could rest.

In North America in ancient times there were no highways like this one built by the Incas. The Indians who lived in our part of the world were not so civilized as those who lived in parts of South America. They never built any cities or temples or palaces, as the Incas did, and when they traveled from one of their villages to another, they made their way over narrow winding paths through the forests. These were called trails and usually followed the paths worn by deer and other animals.

At first the Indian trails went from village to village and to the hunting grounds. Afterwards many were made to the settlements where the Indians

traded with the colonists. Sometimes the trails were beside the banks of rivers, and sometimes they went through the valleys between mountains. The colonists used these same trails. As people tramped over them day after day and year after year, the paths gradually grew a little wider and a little smoother. This was how our roads began.

When people wanted a way to a new place, they started off through the woods, and here and there chopped a small piece of bark from a tree. The white wood under the bark showed up clearly, and the next people who came along could easily follow the way from one marked tree to another. A trail marked in this manner is said to be blazed. Perhaps you have seen one among the mountains. Boy Scouts are taught how to make them. A blazed trail helps people to follow a winding path which may not be traveled very often. In the winter, when the path cannot be seen because of the deep snow, people can find the way by watching for the blazed marks on the trees.

Corduroy roads. The man on horseback is a post rider and carries mail.

In swampy places the colonists often built corduroy roads. They cut logs in two, lengthwise, and laid them close together across the road with the round sides up. This made ribs that looked like corduroy cloth. Roads like these were bumpy to ride over, but they kept horses and carts from sinking into the soft ground. Sometimes they were made a little smoother by being covered with dirt. They were strong enough to carry heavy loads. We sometimes find corduroy roads and corduroy bridges over streams in the woods even today.

In George Washington's time there were no good roads anywhere in our country. His home was at Mount Vernon, which, as you know, is not far from the city of Washington. When he was asked to go to New York to be made President, Washington found that he could not drive in his coach. The roads were so rough that he had to go on horseback, and the journey took seven days. We can make the same journey by train in about eight hours. It takes only a few hours longer by automobile.

Letters written by travelers tell how the roads about a hundred years ago were so uneven that sometimes one side of the stagecoach was two or three feet higher than the other. The wheels were liable to strike the stump of a tree, because when roads were made through the forests, many of the trees were cut down six or eight inches above the ground, and the stumps were left. When they struck these stumps, stagecoaches were often upset or their wheels were torn off. After heavy rains the mud in the roads was often three or four feet deep, since the

ground was soft. Sometimes it took twenty horses to pull a coach out of the mud. Most roads were so narrow that often there were stretches twelve miles long where two carts or carriages could not pass. Imagine what it must have been like to ride over roads like these.

Have you ever driven over a road known as a turnpike? This is an old-fashioned name for a road of a certain sort. Today a road that follows the shortest route between two large cities or towns is often, especially in New England, called a turnpike. For long distances it runs almost in a straight line. Whenever we get to the top of a hill, we can look off and see the turnpike like a narrow ribbon stretching out ahead for miles and miles.

On an old turnpike. The gateman lived in the little house and collected toll from people using the road.

In the old days a turnpike might be straight all the way or it might wind like an Indian trail in order

to cross rivers at narrow parts or to avoid the highest hills. The name turnpike meant that every five or ten miles there was a heavy gate across the road. It had sharp pickets or pikes, so that no one could pass it easily. When a stagecoach or a carriage or a drove of cattle came to this gate, the driver had to pay the gate-keeper a small sum of money, or toll. Then the gate would be turned or opened, and the travelers were allowed to pass. The money that was paid by people using the turnpikes was spent in keeping the roads in repair. Here and there out in the country, we find toll bridges even today, but probably no toll roads.

Hundreds of turnpikes were built in the eastern part of the United States. From several of the large cities they ran out into the surrounding country like the spokes of a wheel.

About one hundred and twenty years ago, people were beginning to settle in the West. The turnpikes did not extend very far from the Atlantic Coast, and of course there were no railroads. So the National Government began to make a road to help people to move to the new territory. This was named the Cumberland Road, because it began at Cumberland, in Maryland. It was built a few miles at a time, across the corner of Pennsylvania and then across Ohio and Indiana, and finally, after nearly thirty years, it stretched halfway across Illinois. Many years later it reached St. Louis.

Along this road thousands of west-bound settlers carried their families and household goods in big wagons, known as Conestoga wagons. There is

more about these in another chapter. Also along this road traveled long pack trains of horses and mules carrying freight. People went from one city to another in gaudily painted stagecoaches, drawn by fast horses. Until the railroads were built, most of the trade and travel between East and West passed over the Cumberland Road. It made it easy for Americans from many different States to get acquainted with other parts of the country, and to become friendly with the people who lived there.

Another name for the Cumberland Road was the National Road, for the plan was to keep on building it westward as fast as the country became settled. It was also sometimes spoken of as the Great National Pike, or turnpike. Today it is named the National Old Trails Road, and it stretches all the way to Los Angeles.

When your father was a boy, bicycles were ridden by thousands of people everywhere. Many men went to their business on their bicycles, and there were bicycling clubs of men, women, and children who rode out into the country for picnics on holidays. In those days city streets were often paved with granite blocks, and riding over them was very rough. The best roads for bicycles were those in the parks, and there were not very many of them. Out in the country, the roads were not broad and smooth like the ones that we know. They were not paved at all, but were just soft dirt roads which were covered with deep dust in hot weather and with thick mud after rains.

Bicycle riders wanted better roads, and they talked

so much about it that before long newspapers and magazines began to urge cities and towns to improve their roads. When automobiles became common, the building of better roads was taken up in earnest. The Lincoln Highway was begun, and that led to the planning of many others.

If we could put all the roads in the United States end to end, we should find that they would reach around the earth more than twelve times. How many miles would that be? If we counted also all our old-fashioned dirt roads, those that have no hard surface, they would reach around the earth ninety times more. In a backward country like China, on the other hand, all the roads of every kind would reach only about three quarters of the way around the earth.

Perhaps you have been wondering who pays for the building and repair of all these roads? A large part of the money comes from the tax on gasoline. All but two or three of our States have laws that place a tax of a cent or two on each gallon of gasoline that is sold. The money raised in this way is turned over to the Highway Department of the State. If any more money is needed, it is taken out of the treasuries of towns, cities, and States. Even the National Government sometimes gives money for the building of a new road.

Travel by automobile, as we have seen, helped in the building of good roads out in the country. It has had a great deal to do with the better paving of city streets, too. Years ago many city streets were not paved at all. They were just as dusty in dry

weather and just as muddy after rains as the old-fashioned dirt roads outside of the cities. Macadam was a great improvement, but it wore out fast even when only horse-drawn carriages and wagons were used. So the cities paved their busiest streets either with round cobblestones as big as your head or with square granite blocks. These almost never wore out, but you can imagine how noisy the steel tires on wheels and the iron shoes of horses made the streets. Nowadays granite pavement is used near warehouses, railroad stations, and steamship piers, where there is a steady procession of heavy trucks all day long, but it is not often laid on streets where there are stores, offices, and homes. Besides being noisy, it is hard to keep clean.

Bricks were tried for paving streets, and so were blocks of wood. We still see them in some cities, but the commonest pavement is asphalt. Cities wish their streets to be easy to clean and as quiet as possible. Also they do not wish to spend too much money in building and repairing them. When everything is considered, asphalt seems to be the best material to use.

When asphalt pavement is laid, the roadbed must be carefully leveled and smoothed. Then a foundation of concrete is laid. Upon this two coats of hot asphalt are spread. Perhaps you have seen men working with big iron rakes to make the surface exactly even from one side of the street to the other. They wear great heavy shoes with thick soles to keep the asphalt from burning their feet. Next, the pavement is smoothed with hot irons on long handles,

and a thin coat of concrete is sprinkled over the top. Finally it is rolled with a very heavy steam roller. It hardens as it cools. After a few hours, it is ready to drive on.

If you have watched a gang of men at work building or repairing a street with this sort of pavement, you know that asphalt looks much like tar. It is made from petroleum, that wonderful oil that comes from wells in Pennsylvania, Texas, California, Oklahoma, and other regions. Years ago paving asphalt used to be made from asphalt that was brought from the island of Trinidad, near the coast of South America. There is a big lake of it there, crusted over with a coat of hardened asphalt strong enough to bear men, horses, and carts, if they keep moving. No matter how much asphalt is cut out anywhere in this crust, more flows up from underneath, and soon hardens so that the hole is filled up. Probably this supply will never be used up.

If the people of a country are wide awake, they do everything they can to improve their roads. They know that good roads make it easier to carry their products to market. They are not satisfied to keep on doing things in the same slow, clumsy way that their grandfathers did.

Some countries have to struggle against difficulties that we in the United States do not have. In China the many rivers overflow their banks so often that even if more roads were built they would always be in danger of being swept away by floods. In large parts of Russia the land is still covered by forests as thick as those that the American colonists had to

cut down. That is one reason why there are so few roads there.

In the hottest parts of Africa and South America there are dense jungles. Immense ferns and thick vines grow so fast in the moist climate that it is almost impossible to keep a road clear. New jungles grow up almost as soon as old ones are cut down. That is the chief reason why in those parts of the world the only roads are narrow trails. It explains why the people there still have to depend on carrying things on their backs.

In other parts of South America and in Asia there are high mountains over which it is impossible to build modern roads. There are only narrow, crooked trails, and freight must be carried by horses, mules, and other pack animals instead of by motor trucks. You will read in another chapter about some of the strange animals used.

Some lands have much more rain than we do. There is little use in trying to build roads in places where a heavy torrent of rain is likely to destroy them very soon after they are built. The ground is always soft. Carts that have tall wheels with broad rims can be pulled out of the mud easier than carts with small wheels. Oxen do not sink into soft ground as horses would. So you will understand why in Chile, for example, you will see so many ox carts, and why their wheels are so big.

Sometimes the people of a country are so poor that they cannot afford to build good roads, except in the cities. This is true of Mexico, where you will see either mules or oxen dragging most of the freight in carts.

You can understand now how much good roads have to do with the development of a country. We in the United States are very fortunate to have the kind of climate which allows the building of roads which can be permanent. On our network of roads we depend not only for pleasure, but for the transportation of many of the things necessary in our daily lives.

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Chapters I–V. City Streets and Country Roads.

How They Carried the Goods. C. G. Muller.

Chapters V. The Roman Road; VI. The Silk Road; VII. The Robber Barons; IX. The Highwayman.

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BICYCLES, AUTOMOBILES AND PEOPLE AFOOT

Bicycles for work and for play — Old-fashioned bicycles — Bicycles the world over — Henry Ford and his idea — Many uses for automobiles — Automobiles in far-away lands — How automobiles were invented — An automobile ride when your father was a boy — Rules for good driving — How we can help to avoid accidents.

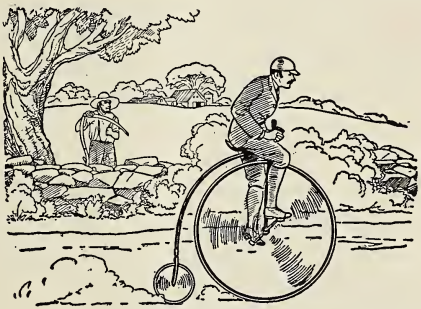
WHEN asphalt pavements were first laid in our cities, the boys and girls who rode bicycles were, perhaps, more pleased than anyone else. Up to that time, bicycling over rough streets had been hard work.

It is great fun to ride a bicycle, isn't it? Of course it would be more fun and much safer if we didn't have to keep out of the way of automobiles and trucks. Still, when there is a long stretch of nice smooth road, without too much traffic on it, riding a bicycle is one of the pleasantest ways of going somewhere.

Bicycles are used in business, too. Telegraph boys and other messengers do their errands much more quickly on bicycles than they could if they had to walk. We often see, also, little delivery carts fastened to the front of a bicycle, because small bundles can be carried in this way cheaper than by automobile.

Old-fashioned bicycles would look very odd to us. The first ones ever made were built of wood and iron, and were heavy and clumsy. The two wheels were connected by a frame on which was a saddle. There were no pedals, no sprocket, and no chain.

The rider perched himself on the saddle and pushed with his feet, much as a small child rides a kiddie car. These bicycles had no springs, and the tires were made of iron. They gave such a rough ride that they were nicknamed bone-shakers. It was not very hard to ride straight along on level ground, and it was very easy to coast down a slope. But when a man came to the end of his ride, he had to get off and lift the whole thing around in order to go the other way. And when he wanted to go uphill, the easiest thing to do was to get off and walk, pushing the velocipede, which was the real name for this machine, along beside him.



An old-fashioned high bicycle.

By and by someone thought of putting pedals at the center of the front wheel. This meant that the rider could go faster, but he had to work pretty hard to do so. The next improvement came when the front wheel was made much larger, sometimes nearly five feet tall. The saddle was way up on top of this big wheel, and a little wheel to help the balance

trailed along behind. The idea was that every time the big wheel went around, the machine traveled farther than the older ones with the smaller wheel. It was hard to climb up into the saddle, and these high bicycles were dangerous, too, for if one struck a rough place in the road, the rider was pretty sure to be pitched head first to the ground.

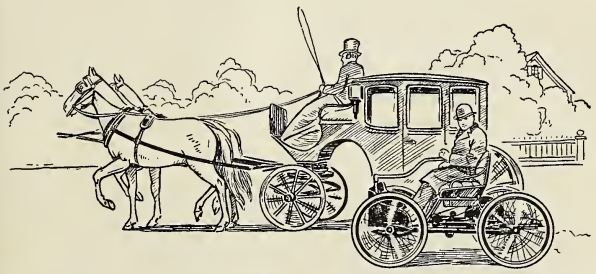
So many people were hurt in this way that the safety bicycle was invented. This is the same sort of bicycle that we ride today, although the new ones are a great improvement over the kind your grandfather rode when he was a boy. For one thing, our bicycles have pneumatic tires instead of solid rubber ones, so they are much more comfortable and they go faster. The coaster brake is another thing that makes modern bicycles easier to manage.

When your father was your age, there were four or five times as many bicycles in our country as there are today. But every year recently has seen the number of riders growing. Perhaps you can think of a reason why this is so. Perhaps you can tell, also, why so many people in Europe and in the cities of China and Japan ride bicycles. When we go to Holland, we shall find girls in their interesting costumes and their big white headdresses spinning merrily along on their wheels, and we shall find men and boys in baggy trousers riding theirs. In Paris in the evening, we shall see many bicyclists with twinkling Chinese lanterns on their handlebars. In Bermuda, unless we drive in a carriage or walk, the only way of seeing the sights of the island is from a bicycle, for no automobiles are allowed there. In

fact, all over the world a great many people use bicycles both for pleasure and in going about their business.

Less than forty years ago, nearly everyone who talked about automobiles could give many good reasons why they would never take the place of horses. Most people thought that these new machines would never be anything more than toys. "They are like bicycles," they said. "We like to have one to ride for fun, but we could get along without it." Nobody dreamed that automobiles would soon be doing most of the work that horses used to do.

Since that time, Henry Ford has made himself one of the richest men in the world by building automobiles. His company has built more than twenty million — or almost as many as all the other American manufacturers together.



Henry Ford's first automobile. In the background is an old-fashioned carriage of the sort called coupé.

Mr. Ford made his first automobile in 1887. This had a steam engine. It was eight years before he built one with a gas engine. All this time he kept

working out new ideas in machine shops, much against the wishes of his father, who hoped that Henry would be a farmer like himself. When Mr. Ford worked for an electric company, the manager kept urging him to give up "playing with automobiles" and to give his time to "something really worth while."

Mr. Ford tells us that for a long time he was the only man in Detroit who owned an automobile. He had to get a special license to drive it on the streets. Probably he was the first licensed chauffeur in the whole country. "If I stopped the machine anywhere in town," says Mr. Ford, "a crowd was around it before I could start it again. If I left it for a moment, someone always tried to run it. Finally I had to carry a chain and tie it to a lamp-post whenever I left it anywhere."

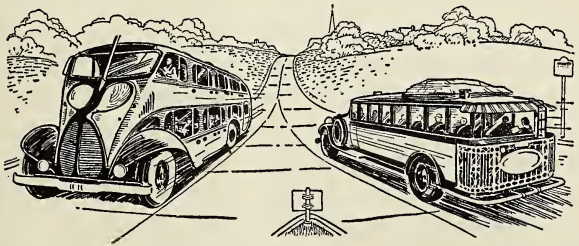
Mr. Ford drove this car about a thousand miles in the years 1895 and 1896. Then he sold it for two hundred dollars to get money to build a better one. Later, when he was a wealthy man, Mr. Ford hunted up his first little automobile and bought it back. He now has it in his museum in Detroit.

In 1896, the Barnum and Bailey Circus advertised a "horseless carriage" as a great curiosity. Today there are enough automobiles of all sorts in the United States to give one to every fifth person, counting children as well as men and women. About how many cars would this be? If it were possible to bring all these automobiles together, they would form a procession twenty cars wide stretching all the way from the Hudson River to San Francisco. Three

quarters of all the automobiles in the world belong to people in our own country.

There are pleasure cars, motor cycles for the police, fire apparatus, ambulances, delivery wagons, snowplows, all kinds of trucks, tractors, and busses. What other kinds of automobiles have you seen? These few hints will help you to make up a long list.

Many boys and girls live in the country, perhaps three or four miles from their school. Motor busses call for them in the morning and bring them home again after school. There are other big busses running regularly from one city to another. Some of these go from coast to coast, carrying twenty passengers or more. Some of the largest of them are arranged as sleepers. They are double-deckers. They have big chairs which at night are flattened out and made into full-length berths. They have even a washroom. Meals can be served aboard, for there is a tiny kitchenette. People who have taken trips in these busses say that they are very comfortable and are pleasant to travel in.



On the left is a double-decked sleeper bus, for long journeys. The other bus is used on journeys of not more than one day.

The Fifth Avenue busses in New York City take the place of trolley cars on that street. It is great fun to ride on the top, where we can look into the shop windows over the heads of the crowds on the sidewalks. The street itself is jammed with several lines of cars, some going uptown and some downtown. Except when traffic stops to let cars cross the avenue from the side streets, all the automobiles travel surprisingly fast. We can look far ahead and at one corner after another see the lights that control the traffic. They change from green to red or yellow and back again, and the system works so perfectly that traffic jams seldom occur, and accidents are very rare.

Once in a while, out in the country, we have seen an automobile fitted up as a tiny traveling church, as a small grocery store, or as a library. We have seen also milk tanks built like huge thermos bottles. They carry milk from farms to the city and keep it at the right temperature. There are also refrigerator trucks with spaces for ice. These carry eggs, butter, fruit, and vegetables long distances without spoiling.

If you have seen the moving pictures that Admiral Byrd brought from the South Pole or the ones that Commander MacMillan brought back from the Arctic you will remember the snow-mobiles. These are everyday automobiles, but instead of front wheels they have runners. There are four rear wheels, two on each side, arranged with a caterpillar tread like some of the farming machinery we see at home. A caterpillar tread, you know, is made up of broad steel plates jointed together into an endless chain. This

passes around the two sets of rear wheels, and as they turn, the endless chain makes a sort of track for the wheels to run on. It bites into ice or snow or soft ground. It helps cars to climb over slopes and rough places where ordinary wheels could not go at all. The explorers found their snow-mobiles very useful, and the Eskimos were delighted to ride in them.

Nowadays there are very few parts of the world where automobiles cannot be used. Even in deserts, those equipped with caterpillar treads and huge pneumatic tires have easily traveled through the shifting sands. They usually have a big roller fastened on in front of the car to help make the path a little more solid.

It may be that some day automobiles will entirely take the place of camels in desert lands. One truck can carry as much as twenty camels. Like a ship in a heavy sea, an automobile rides over the rolling sand dunes that camels usually go around. The same journey can be made in two days that the slow-moving camel caravan would require six days to make.

Automobiles are now used in even the most remote parts of Africa, wherever there are roads. One of the most common obstacles to road making through the jungle are the trees that so often are blown down or that fall from other causes. Sometimes cars can drive under the great trunks, but in other cases the tree must be chopped or sawed apart. Giant ant-hills are even harder to remove. Once in a while the road builders come to one taller than a man. It

takes a great deal of work with pick and shovel to dig these huge piles of earth away.

In one part of Africa is a native kingdom, Abyssinia, where the people are all black. Even here automobiles are used and the natives learn to drive them. The king always has the best car in the country. But even if it is a beautiful big limousine, a special seat is rigged on behind for the servant who must always hold a parasol over the king's head.

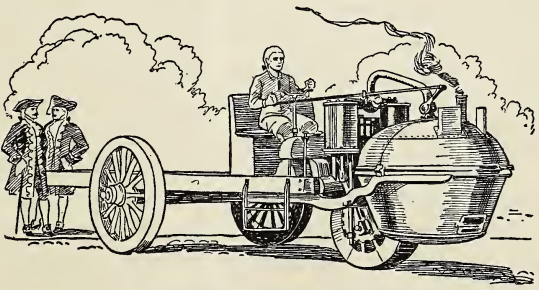
The people of Japan have been quick to see the advantages of automobiles. Not only are there many taxicabs and private cars in Japanese cities and towns, but motor trucks are being used instead of the coolies, or men who carry burdens on their backs. Now and then heavy loads are still dragged through the streets by man power. There may be as many as ten men pulling on ropes. But more and more trucks are coming into use in Japan year by year.

In China the story is different. That country has few good roads. It is only in the cities that there are any large number of automobiles. Another part of this book tells about some of the strange Chinese vehicles.

All through Europe there are networks of fine smooth highways. We shall not see quite so many private cars as there are in our own country, except in the big cities. However, wherever tourists go we shall meet sight-seeing busses, known as charabancs, filled with people eager to see the quaint little towns, the cathedrals, the palaces, and all the other interesting sights that abound in Europe.

The story of how automobiles came to be, like the story about engines, ships, and airplanes, begins many years ago. Men of several different countries worked long and hard trying to find out the way to build machines that could be driven on roads. The automobile is not the invention of any one person. The ideas of many men helped to make better and better machines, until today we have automobiles that seem perfect.

About seven years before the signing of the Declaration of Independence, a Frenchman named Cugnot built a queer-looking steam carriage. This was planned to drag heavy freight along a road, not to run on a track like our locomotives. It was not intended for passengers. It had three wheels, two at the rear and one in front. Out beyond the front wheel hung a big round boiler in which steam was raised. The supply of steam lasted only fifteen minutes. Since the car ran only about two miles an hour, you can see that it could not go very far before the engineer had to stop for more water so that he could raise more steam.



Cugnot's steam carriage.

While on a trial trip, Cugnot's steam carriage came to a sad end. It ran into a stone wall and was wrecked. The inventor was thrown into prison and forbidden to work on his steam carriage again. There is a small model of this machine at the Museum of Science and Industry in New York City. In the same room are some early American automobiles and also a car of the present day. In other rooms you will find hundreds of models of ships, locomotives, and other means of transportation. Some of the models work by electricity. You can press a button and watch them go.

A few years after Cugnot's experiment, an Englishman named Murdock made a small model steam engine. One dark night he was trying it on a road near a village. He lighted the lamp under the boiler to make steam, and before he knew it, away ran the model down the road. Murdock chased it as fast as he could, but before he caught it he heard shouts as if someone was frightened. He found that the village minister was on his way to church. Hearing strange puffing sounds behind him, the minister looked over his shoulder. Dashing toward him came what might be a dragon with fire and smoke pouring from its mouth. The frightened minister had never heard of a steam engine that could run on a road. When he saw this one, with its red-hot smokestack and its clanking machinery, he thought the best thing to do was to run for his life. The ideas worked out in this car led to nothing, for the inventor had no money left after his experiments with models.

Another Englishman, whose name was Trevethick,

soon made a locomotive that was able to pull cars loaded with ten tons of iron and seventy men. A friend of his once wrote a letter about this engine. "One day," he says, "we started about four o'clock in the morning and went along one of the streets of London. Sometimes we traveled at the rate of eight or nine miles an hour. I was steering and Captain Trevethick and someone else were attending to the engine. The Captain stepped over to me and said, 'She's going all right.' 'Yes,' said I, 'but I think we had better go out into the country.' She was going along five to six miles an hour, and the Captain called, 'Put the helm down, John!' Before I could tell what was the matter, the Captain's foot was upon the handle of the steering wheel. We were tearing down seven or eight yards of railing from a garden wall! A person put his head from a window and called out, 'What are you doing there? What is that awful thing?'" Perhaps it is no wonder that this person was puzzled and frightened by such a strange vehicle.

Many years later other Englishmen working together succeeded in building steam coaches that worked very well. Several of their machines carried passengers regularly to cities and towns near London. They were allowed to go only four miles an hour, and a man with a red flag had to run along ahead to warn people that the new-fashioned monster was coming.

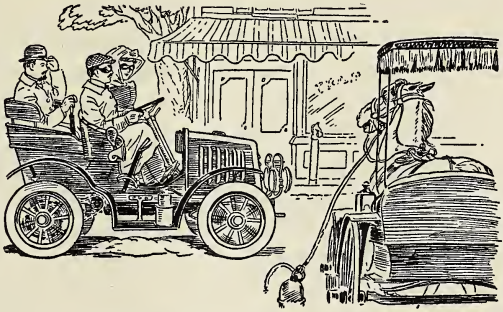
These steam coaches had six wheels, the two small ones in front being used for steering. Except for the boiler and smokestack sticking up behind,

they looked a great deal like the horse-drawn stage-coaches that were so common at that time.

People complained, however, that heavy steam engines tore up the roads, frightened horses, and filled the air with hideous noises as well as smoke. Just at that time, too, railroads were beginning to be built in England, so road locomotives never came into much use.

Just one hundred years after the Declaration of Independence, a German inventor named Otto made the first engine that burned gasoline instead of coal or wood. During the next twenty years Germans, Frenchmen, Englishmen, and Americans all worked to make better engines of the same sort. If a good gasoline engine had never been made, there might never have been any automobiles, at least of the sort that we know.

The first automobiles were spoken of as horseless carriages. When a man set out to build one, he was likely to make a thing that looked very much like an old-fashioned buggy. It had big wooden wheels with steel tires, the seats were perched up higher than the wheels, the engine was beneath the floor of the carriage, and it had either one or two cylinders. It made a loud sputtering noise that startled people on the sidewalks and frightened horses so that they ran away. Instead of a steering wheel, the driver moved a rod like the tiller of a boat. People knew so little about the machinery that one man in England who bought a car in Germany spent nine days trying to find out how to start it.



An automobile of about thirty years ago.

The early automobiles were all open cars without even a windshield. When people went to ride, they wore big goggles over their eyes, and long linen coats called dusters. The women covered their hats and faces with heavy veils. The driver thought he was rushing over the road if he could make the car go twenty miles an hour. Towns put up warning signs that a driver would run the risk of trouble with the police if he drove more than fifteen miles an hour through the town. There was a queer-sounding horn which the driver could honk if he saw in the distance a carriage or a wagon drawn by a horse. Out in the country drivers had to be very careful not to run over hens or frighten cows that they might meet along the road. The machinery made so much noise and the engine chugged so loudly that the passengers could hardly hear each other's voices.

Sometimes a car had seats for only two people. If more wished to go for a ride, there was an arrangement like a big square painted box, made of steel

and wickerwork, that could be fastened on behind the seats. It had cushioned benches running along the sides, and a door at the back that was closed and bolted after everyone was seated. Passengers got in by climbing three or four steps.

It was thought a great advance when smaller wheels, something like bicycle wheels, were used on automobiles. Some of the first ones had heavy ropes for tires. Next, solid rubber tires were tried. Tires pumped full of air were already used on bicycles, so the same sort were made for automobiles. People were very lucky, though, if they got back from their ride without a punctured tire. If they had to repair a tire on the road, it took an hour or more to do it. A very common thing was to see a party of people sitting on the grass by the roadside while waiting for a tire to be mended. Often, too, one saw a man lying on his back under his car while he tried to find out why his engine would not go. Many times cars that started out merrily enough had to be dragged home by a horse because something had gone wrong with the machinery, and nobody knew how to fix it.

It was several years before there were any automobiles with tops. When Henry Ford went driving on rainy days, his wife used to sit beside him holding an umbrella over his head. Some of the first tops were flat, something like the delivery trucks of today, with an iron post at each corner. Others were like huge umbrellas. Most were like the tops of old-fashioned carriages, and could be folded back in pleasant weather. When a storm came up, it took at least two men to put the top up again. There

were curtains that could be buttoned along the sides to keep out the rain. Closed cars like sedans and limousines were not made until fairly recently.

If you can find some old magazines at home or in the public library, you will see in the advertising pages pictures of many strange-looking automobiles. But in those days people thought their cars just as beautiful as we think this year's models are. Perhaps the cars built a few years from now will be very different from ours today.

Nearly all people who drive automobiles are careful to do everything they can to avoid accidents. Here are some questions that an insurance company printed a little while ago as a sort of test for drivers. If a person can answer each one "Yes," he can score ten points and can call himself a good driver. Perhaps you would like to show them to your mother and father.

1. When you are driving your car, do you keep "Safety First" in mind?
2. Do you keep in the line of traffic?
3. Do you watch other cars, so that whatever they do you can keep out of trouble?
4. Do you watch for people on foot, especially children?
5. Do you slow down near schools, railroad crossings, and street corners?
6. Do you signal to the car behind when you are about to make a turn?
7. Do you always keep your car under control?
8. Do you keep in line when coming to the top of a hill or to a sharp turn in the road?

9. Do you obey traffic rules and signals?

10. Do you have your car, especially the brakes, examined regularly?

In all American cities, big and little, everybody seems to be in a hurry to get from one place to another. Besides thinking of how quickly we can get somewhere, we ought also to think of how we can go safely. Too many people think only of hurrying. That is one great reason for accidents. It is just as necessary for people who are walking to think about safety as for people who are driving cars. Here are a few safety rules that we ought to remember all the time.

1. Learn the traffic rules in our city.

2. If there are traffic lights, know what the different colors and combinations of colors mean.

3. If there are traffic officers at street corners, be sure to follow their signals.

4. Where there are no traffic officers or signal lights, look first to the left and then to the right before you start to cross a street.

5. Never cross a busy street except on crosswalks.

6. Do not get out of an automobile on the street side.

7. Do not get off a moving street car.

8. On country roads or highways, walk on the left-hand side. Can you tell why this is good advice?

In some places there are "Careful Children Clubs," organized for boys and girls by the grown people on the Safety Council of the city or town. Members must agree to keep this pledge:

"I will not play in the streets.

I will not chase a ball in the streets.
I will not steal a ride on any truck, automobile, or trolley car.
I will not run out suddenly into the street.
I will choose a safe place to play — my Community Playground."

Talk these rules and this pledge over with your family and friends, and see if anyone can add any ideas that will add to the safety of children in your community.

Most cities now have rules that not only speed up the traffic, but also help people on foot to avoid accidents. A "One Way Street" sign means that automobiles on that street must all go in one direction. You can see how much safer for everyone this makes a street.

The parking of cars is allowed only on the wider streets and only during certain hours. How does this add to our safety? Some important thoroughfares are marked "Through Way Begins Here," and "Through Way Ends Here." These signs mean that automobiles traveling on the parts of these streets set off by these signs have the right of way. All traffic which enters from a side street must stop before doing so.

At all important corners, there are either "Stop" and "Go" lights, or else traffic officers who give signals to the drivers of automobiles and the people who are walking. At many other corners there are lights which flash every second or two, as a warning to everyone to make sure there is nothing in the way. On some busy streets there are underground

crosswalks, so that people can pass from one side of the street to the other without waiting for the automobile traffic to stop.

Probably you know several other plans that are followed in your community to make the streets safe. What signs, for example, do you see near your home or your school, or downtown? Is there a safety patrol of Boy Scouts? Do any of your schoolmates help traffic officers just before school opens or just after the session ends? If you ever have a chance to talk with a traffic officer about safety for everyone, you will find that he can tell you many interesting things.

Perhaps you have wondered why trolley cars are so often painted in bright colors, such as yellow and orange. In some cities the ends of the cars are painted white. Why is this done? Light colors show wear much more quickly than dark ones do. You might naturally expect the street railway companies to choose colors that would look well as long as possible.

The reason for orange or yellow paint is that cars painted in these colors catch the eye of automobile drivers. There is no danger of running into a trolley car if the people in the automobile see it soon enough. In the same way, white shows up clearly after the street lights are on and so helps to avoid accidents at night.

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What Makes the Wheels Go 'Round? G. E. Bock.
Diagrams in color explain how steam engines, gas engines, and Diesel engines work.

TROLLEY CARS, SUBWAYS, AND ELEVATED RAILWAYS

Do we need trolley cars nowadays? — How were old-time street cars different from ours? — Cable cars — What is the "Elevated"? — A ride in a subway.

A FEW years ago there were many more trolley lines than there are now. Cities had them on most of their important streets, and they ran out into the country and from one city to another. Automobiles and motor busses have become so popular that in some places nearly all the trolley cars have been given up. They are still, however, a convenient way of taking people to and from their work. The streets are so crowded with automobiles early in the morning and at the end of the day that travel downtown is likely to be quicker by trolley than it is in an automobile. People who live in the suburbs of a big city like to go in town by trolley, because they do not have the trouble of hunting for a parking place for their cars. So trolley cars will doubtless be much used for many years to come. When we go from one city to another, however, motor busses or railroads are quicker and more comfortable. And when we go for a ride in the country, we choose an automobile.

Trolley cars run by electricity. There are power houses with great dynamos where the electricity is made. Overhead wires carry the current through all the streets on which the car tracks run. On the top of each car is a long pole with a little wheel or trolley at the end, by which the current is taken from the wire into motors inside the car. These motors

Modern city streets are carefully planned. What is done to avoid accidents? How is traffic speeded up? What vehicles can you find in this picture?

turn the wheels and make the car go. Then the electric current passes into the rails and flows back to the power house. The electricity has to make this complete circuit or else the car will not run. You have no doubt seen a car whose trolley has jumped off the wire. This breaks the circuit and the car stops until the motorman succeeds in putting the little wheel back on the wire.

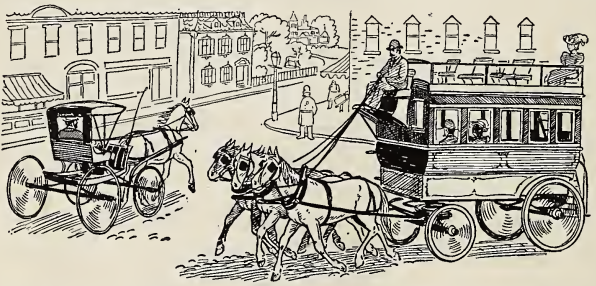
Trolley wires and the posts that hold them are not beautiful to look at. In New York and Washington we see none, for they are not allowed in those cities. Instead, between the tracks, we shall see a narrow slot in the pavement. The wire from the power house runs in a sort of trough, or conduit, below this slot. Electricity is taken into the motors of the cars by a rod which extends down through the slot and touches the wire.

The first street cars in the United States were used in New York City many years ago. They took the place of the old-fashioned coaches, known as omnibuses. Like them, they were drawn by horses. The chief difference between an omnibus and a street car was that the street car ran on rails, while the omnibus could go anywhere.

The street car could carry more people. Instead of facing the front like the seats in modern trolley cars, these seats ran lengthwise along the sides. In an omnibus the seats were arranged like those in a stagecoach. Some of the passengers had to ride backwards. An omnibus was as gaily painted as the band wagons of a circus and just about as uncomfortable to ride in. The horse cars running on

rails were thought to be a great improvement. Passengers were allowed to get on and off wherever they wished. Special stopping places for street cars were not thought of for many years.

The first street cars were painted, like the omnibuses, in bright colors, blue, green, and yellow, or in checkerboard fashion. They also had many signs naming the parts of the city to which they went and the streets they traveled on. There were usually bells on the horses' necks, except on Sunday, when



Before the days of automobiles and electric cars. Here we see an old-fashioned buggy, and an omnibus.

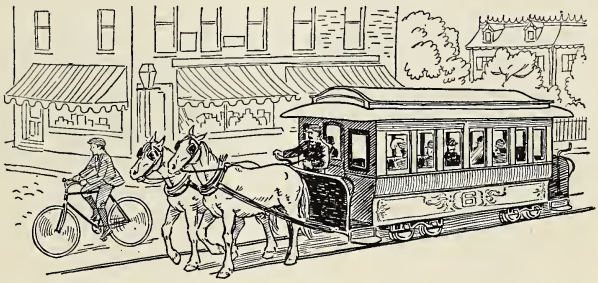
people thought that all noise should be avoided as far as possible.

When your grandfather was a boy, he probably rode on very small horse cars. They were about half as large as the one-man trolley cars that we now see in some cities. There was a platform at the front for the driver, and the only entrance was at that end.

Perhaps there was only a single track, with turnouts here and there so that cars going in opposite

directions could pass. When a car reached the end of the line, it was put on a turntable and turned around.

Two horses pulling a loaded street car made a sight very different from anything to be seen in our day. On level ground, the horses trotted along side by side, easily drawing the car along the rails. When they came to a hill, the driver did his best to make them gallop, so that the car might get a good start up the slope. A little distance up the hill a



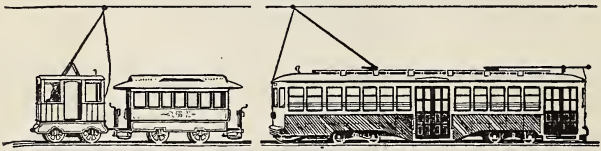
Other means of transportation on city streets were bicycles and horse cars.

third horse with a boy on his back would be waiting. The boy would leap to the ground and hitch the horse to a ring in the front of the car. Then with much whistling to the horse and some whipping, we are sorry to say, the three horses would pull with all their might and main and finally drag the car to the top of the hill. There the chain horse, as the extra one was called, would be unhitched. Back he would go to help the next car.

In cities where there was a great deal of snow in

the winter, the tracks were not cleared. Instead of the cars, horse-drawn coaches with runners in the place of wheels went through the streets. They were heated by small coal stoves, and their floors were strewn with straw to keep the passengers' feet warm. They were lighted by smoky kerosene lamps.

Your grandfather probably had his first ride on a trolley car about fifty years ago. Perhaps he will remember what an exciting experience it was, almost as exciting as our own first ride in an airplane. Perhaps he can tell you how people were at first a little afraid of this new invention. The cars certainly made strange noises, and often sparks flew from their motors and trolleys. In his poem "The Broomstick Train," Oliver Wendell Holmes pretends that it was the witches that made the cars go. You will enjoy reading it sometime.

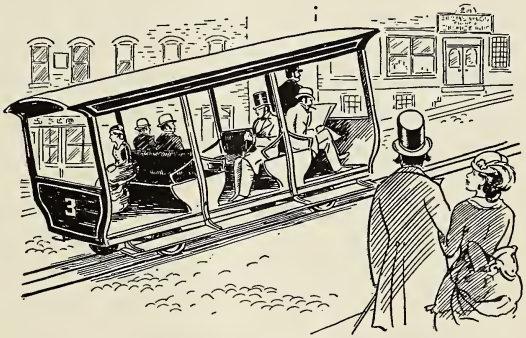


At the left is one of the earliest trolley cars. It is an old horse car attached to a small car carrying the motor. At the right is one of the big trolley cars of today.

The first trolley cars were much smaller than the ones we see. They were hardly any larger than the horse cars had been, but they went faster. There were no air brakes like ours, so when the motorman wished to stop, he had to wind a crank by hand. The warning signal, when anything got on the track.

was a big clanging gong. Some motormen seemed to keep ringing it most of the time.

People did not like to see trolley wires strung through so many streets. They wondered, too, what would happen in case of a bad fire. How could the firemen put up their tall ladders where the wires were in the way? No one had yet learned how to run electric wires under the ground. By and by someone thought of cable cars.



An old-time cable car in San Francisco.

Nowadays we do not see cable cars in many cities, for the plan was found expensive. They still have them in San Francisco, because that city has many steep hills, and cable cars climb their long slopes better than trolley cars.

Cable cars work like this. Along the middle of the track is a slot much like the one connecting the conduits used under the New York electric car lines. Instead of a wire, a heavy endless cable connected

with a power house is kept running through the conduit. The cable car has an arrangement called a grip which reaches down through the slot and takes hold of this moving cable, much as you would grasp a rope with your hand. When the grip is closed, the car goes along as fast as the cable does. When the grip is opened, the car stops because the cable slides through it. If the grip is partly open, so that the cable is not held tightly, the car moves at a slow speed.

A little more than sixty years ago, the people of New York found that their city was growing so fast that the lines of street cars could not take care of the great crowds going downtown in the morning and home again at night. There was no room for any more lines on the surface of the streets. What was to be done?

They decided to build railroads above the streets. They set up strong iron and steel pillars about as high as the second-story windows of the houses and laid the tracks upon them. This was named the elevated railroad, and for short it came to be known as the "L." In places this new railroad was on the level of the third stories. At certain distances stations were built, with stairways leading down to the street.

At first locomotives that burned coal were used, but these made so much smoke and noise that everyone was glad when trains run by electricity were introduced. The "L" trains do not use trolleys. Instead there is a third rail running alongside the track. This brings the electric current from the power house. Pieces of steel called shoes reach out

from the motors of the cars and slide along this rail. This closes the circuit in the same way that the trolley does on the surface cars, and the electric current keeps the wheels turning. When we see a train of several cars running on an elevated railway without even a trolley pole in sight, it looks much like magic. There are elevated railroads in New York, Chicago, Philadelphia, and Boston. The one in Boston is also connected with a subway. An incline takes the trains from tracks high up in the air to other tracks deep below the ground.

A subway is a tunnel below some of the streets of a city. Cars that run there may be either trolley cars brought in on tracks that connect with those on the surface, or third-rail trains. Both kinds are used in Boston. In New York the third-rail plan only is used.

There is also a subway in Chicago, but there the cars are for freight only. Coal, ashes, and dirt from the foundations of new buildings are all hauled away underground. So is freight of all kinds, since the cellars of stores and warehouses in the business section of the city are connected with the subway, which runs to the railroad stations and the steamship piers.

Let us take a ride on one of the New York subways. We must be careful to find an entrance to the right station, for we should not like to be carried downtown when we wished to go uptown. Here is one, close to the entrance to a store, with signs telling clearly where the trains go.

We go down the stairs, almost as if we were going

into the basement of a building. There is a turnstile into which we each drop a nickel. This unlocks the turnstile, and we pass through to a long, wide platform. The name of the station is printed in large letters in several places on the white tiled walls. Each station has its own color, too, so that people on the trains can quickly tell one station from another.

Presently our train comes in, the car doors slide open, and we step into a car. The tracks are sunk below the level of the platform, so that the floor of the car is even with the platform. This saves time for people who are getting on or off, and it helps to prevent accidents. The doors close and away we go. We have hardly started before another train dashes by us, going in the same direction on a track close beside ours. That was an express train. It stops at only a few of the stations. People who go long distances in the subway usually take an express train at one station, and stay on it until they reach the station nearest where they wish to go. Then they can change to a local train, which stops at every station, and ride still nearer their home, or store, or office. You can see how this saves them much time.

Our train rushes on through the well-lighted tunnel. Someone tells us that the steel columns holding the roof are five feet apart, but we go so fast that they look almost as close together as the pickets in a fence. More and more people board the car at one station after another until they seem to be crowded together like a package of pencils.

On a long stretch, an express train may run

through the subway as fast as fifty miles an hour — much faster, of course, than any car or automobile could go in the crowded streets. It is perfectly safe, however. There is a system of signals which prevents any train from getting too close to the train ahead. There are heavy guard rails which prevent the trains from jumping the track. Even if a train should leave the track, special brakes would stop it in a very short distance, and heavy pillars would keep it from the track alongside.

The first subway in New York was built a little less than thirty years ago. At that time people believed that it was the only one that would ever be needed. Since then, however, so many more people have come to live in and near New York that a network of other subways has been built. In all they are more than two hundred and twenty miles long. If there were twice as many subways, they would probably still be crowded at rush hours.

The different subways are not all the same distance underground. Some of them run below others. The deepest ones are so far down that there are elevators to carry passengers to and from the surface.

If we were to add up all the miles of car tracks in New York City, counting surface tracks, "L" tracks, and subways, we should get a total of more than six hundred miles, which is more than half the distance between New York and Chicago.

WHAT TO READ

Transportation. W. F. Rocheleau.
Chapter VI. Electric Railways.

Travelers and Traveling. E. M. Tappan.
Chapters V–VII. About Trolley Cars and Subways.

The Ways We Travel. Frances Carpenter.
Chapters X, XI. Electric Cars and Subways.

The Wonder Book of Electricity. Harry Golding.
There are chapters on "How a Power Station Works," "Electric Railways," and "Automatic Traffic Control."

BRIDGING THE RIVERS

How natural obstacles are overcome — How a drawbridge works — Going to sea to learn about bridges — Bridges of different kinds — Some celebrated bridges — A railway through the sea — Memorial bridges — How the Romans built bridges — Bridges in other parts of the world.

WHEN a railroad or a highway comes to a river, it must cross it by means of a bridge over it or a tunnel under it. When it comes to mountains, either it must zigzag up the easiest slopes or burrow through. This chapter tells about some of the most wonderful bridges in the world, and the next one tells about some famous tunnels. We shall see how men have overcome obstacles in the way of travel by land, and how trains and automobiles can now follow routes that are much shorter than any around these obstacles would be.

A bridge is such an everyday affair that most of us, when we cross one, think little or nothing about it. We forget, perhaps, that if there were no bridges, we should often have to wait at railroad crossings for trains to pass, and when we came to a river, we should have to wait for a ferry.

Once in a while, of course, we may get part way across a bridge over a wide river, and then have to wait because the draw is open. If we are not in too much of a hurry, this may be an interesting experience, for we can learn how the draw works. A draw, as you probably know, is made in a bridge for just one purpose, to let vessels pass through. But all draws are not alike. Sometimes a long section of the bridge is swung to one side, out over a pier

running crosswise to the bridge. Sometimes, when there is no room alongside the channel for this pier, the draw works like a turntable in a railroad roundhouse. In a few bridges, the part over the channel is lifted straight up into the air like an immense elevator.

We should hardly expect to learn much about bridges while traveling on a steamboat. There is, however, one short voyage on which we can see a number of famous bridges, some of one kind and some of another. This voyage is from Boston to New York, on the steamer that goes through the Cape Cod Canal.

In the evening, a few hours after we leave Boston, comes the passage through the canal, with its winding channel, its signal lights, and its bridges with draws that lift to let our steamer through. One of these draws, when raised, looks as tall as a ten-story building. It is hinged at one end like the blade of a jackknife. It works much as the drawbridge over the moats of old castles used to work, but of course it is very much larger and heavier. Electric machinery is used to open and to close the draw, and as our steamer passes through, we hear the clanking of heavy gears.

Drawbridges of this sort are often used where railroad lines cross rivers. There is a heavy weight which goes down as the draw goes up, and so acts as a counterbalance, like a window and its weights. Such a bridge is called a rolling lift-bridge, because at the hinged end are huge rollers, shaped like half a cylinder. Cog wheels along their lower sides fit

into a sort of track. As these turn, they gradually raise the draw. If the bridge crosses a wide river, the draw is usually made in two halves. One half is raised from each bank.

We are surprised to see that the Cape Cod Canal is hardly more than a deep ditch with sloping banks of sand. In some places it is so narrow that we are sure that we could throw a stone ashore. The canal is about thirteen miles in length. It saves a long trip around the end of Cape Cod, where the water is likely to be rough and where many ships have been driven ashore on the treacherous sands. Cape Cod Bay, we remember, is the place where the Pilgrim Fathers first anchored their ship, the Mayflower.

We are up bright and early next morning in time for all the interesting sights we shall see as we enter the harbor of New York. One of the first things we notice, in the distance, off to the right, is what looks like an endless row of tall concrete arches set in a wide curve. Presently it curves toward the river, sweeps over our heads, and disappears far away to the left. This is the Hell Gate Bridge, on which through trains run on their way between Boston and Washington. This bridge is more than three miles long. Before it was built, the trains had to take a roundabout route and be carried across a stretch of water on huge ferryboats.

Farther down the East River, we steam under four great bridges that connect New York and Brooklyn. The first three all have towers of steel lattice work which look more or less like the towers you build with your Meccano sets. They come in

this order — Queensboro, Williamsburg, Manhattan, and Brooklyn. They are all suspension bridges except the Queensboro, which is a cantilever bridge. Later in this chapter you will find an explanation of the difference between the two kinds.

Brooklyn Bridge. The towers are built of stone.

Just now we wish to study the Brooklyn Bridge, for it is the most famous and the most interesting, as well as the oldest of all the bridges across the East River. It is one of the most beautiful suspension bridges ever built. Fourteen years were needed to finish it. The men who planned this bridge say that if small repairs are made from time to time, it ought to last for thousands of years.

Brooklyn Bridge has two double towers of stone. Each is 329 feet tall. Between them run four great cables in a graceful curve. Each cable is about sixteen inches thick, although you would never guess it when you look up from the deck of the steamer. Each cable is made up of bundles of thousands of small but very strong wires carefully wrapped to keep out moisture. From these cables, the bridge itself is suspended.

There is a roadway for automobiles and trucks, double tracks for trolley cars, and a broad walk for foot passengers. On any day in the year almost 200,000 people cross this bridge of whom about 4000 go on foot.

Queensboro Bridge.

Now, how does a cantilever bridge differ from a suspension bridge? We may compare a suspension bridge to a hammock, slung between two posts. A cantilever bridge is something like a bookshelf whose two ends are held up by brackets. It is built in a series of spans. Starting from two strong towers set on firm foundations, steel work is built out from each side of the towers. This is arranged so that the bracket on one side balances the bracket on the other. The gap between the end of one bracket and the end of the one opposite is spanned by girders of steel, upon which the floor of the bridge itself is laid.

A cantilever bridge is thus made into one solid structure of steel. Most of the weight is supported

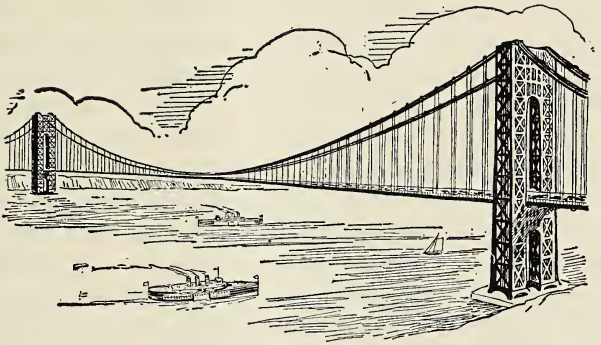
by the piers, or towers. In a suspension bridge, on the other hand, the weight is carried mostly by the cables.

Suspension bridges swing more than cantilever bridges do. If a regiment of soldiers were to march across a suspension bridge, they would be ordered not to keep step. The steady tramp of many men all marching in rhythm would not only make the bridge swing from side to side, but it might put too heavy a strain upon the cables.

When a suspension bridge is to be built, the first wires may be carried across the river either by a kite, or by a rocket to which a light line is fastened. Men on the opposite bank haul in this line until they get the end of the wire ashore. Then they make it fast to the top of the tower, and are ready to begin spinning the cables.

Have you ever taken a piece of string and made a cat's-cradle? The cables for a suspension bridge are woven in much the same way. The towers on the two banks of the river are like your fingers. A wheel runs back and forth between them, leaving behind it on each trip a strand of wire about as thick as a lead pencil. Thousands of these wires are bound together until a cable is built up strong enough to hold the bridge and the traffic on it.

While this is going on, the ends of the cables are looped over the tops of the towers and anchored in enormous stone or concrete foundations on the two sides of the river. In this way the downward pull of the bridge is balanced. Sometimes these foundations are hollowed out 250 feet deep in solid rock.



The George Washington Memorial Bridge. The towers are built of steel.

In October, 1931, the longest and strongest suspension bridge in the world was opened for travel. It crosses the Hudson River. One end is in New York City, and the other is in Fort Lee, New Jersey. This is the George Washington Memorial Bridge. Its central span is 3500 feet, and the side spans are each 650 feet. Near each shore is a great tower of steel, whose top is 635 feet above the water. This is 80 feet higher than the Washington Monument. If you have ever been to our national capital, you will remember how very high that monument is, and you will have a good idea of the height of this new bridge. The bridge itself is almost twice as far above the water as any of the four across the East River that we have been reading about.

There is a suspension bridge in Colorado that is even higher in the air than the George Washington Bridge. This bridge crosses the Royal Gorge near

Canyon City, and is 1050 feet above the bed of the Arkansas River. This is almost exactly the height of the Chrysler Building, which is one of the tallest skyscrapers in New York City. Think of the immense amount of work and the skill it took to build so long a bridge so high in the air.

A suspension bridge across the Golden Gate, at San Francisco, which is now being built, will have a span 700 feet longer than the longest one in the George Washington Bridge. Its towers will be 100 feet higher. Perhaps some day there will be a suspension bridge somewhere else even larger still, for no sooner is one great bridge built in one place than one larger still is built somewhere else.

There is being built also a bridge between San Francisco and Oakland. This will be partly suspension and partly cantilever. In crossing an island in the bay, a short tunnel will connect two parts of this bridge.

Perhaps you have seen some other famous bridge. There is a wonderful suspension bridge across the Niagara River two miles below the Falls, another across the Hudson River at Bear Mountain, New York, one across the Delaware River between Philadelphia and Camden, New Jersey, and still another, called the International Bridge, between Detroit, Michigan, and the Canadian city of Windsor.

There is a remarkable cantilever bridge across the St. Lawrence River at Quebec, one across the Columbia River (the Longview Bridge) in the State of Washington, one at Charleston, South Carolina, named the Cooper River Bridge, and another span-

ning the Snake River Canyon near Twin Falls, Idaho.

You may find it hard to believe that a freight car could be loaded anywhere in the United States and taken all the way to Havana, Cuba. But this is wholly true. A bridge of concrete arches built on the little coral islands stretching out from the tip of Florida is one thing that makes it possible. This bridge is built much like Hell Gate Bridge near New York City, and trains run on it for 128 miles with the waves of the ocean dashing up against the bridge on each side. At Key West, Florida, the freight cars are run aboard a big steamship which ferries them 100 miles more to the coast of Cuba. The rest of the journey to Havana is over everyday railroad tracks.

There is also a famous railroad bridge in Utah. The Great Salt Lake in that State is the largest body of salt water anywhere in the world except the oceans and the seas. Years ago railroads had to go around it. There were long distances where the tracks wound in and out between mountains, and there were steep slopes to climb. So it was decided to build a bridge across one arm of the lake. This is now in use, and makes the main line between Ogden and San Francisco shorter and much easier.

This bridge is built of wood, and is twenty miles long. When they were building it, the engineers came to one place where the water and mud were very deep. When they drove in a pile like a telegraph pole, it went down and down until it went completely out of sight. Then they drove another pile straight down on top of the first one. Finally

they struck a firm foundation. Most of the distance, however, the water was shallow, and there was no such difficulty. There is no danger that the wooden piles supporting the bridge will rot, because they stand in salt water. The lake, you will be interested to know, is about seven times as salt as the ocean. This makes it so easy to float that no swimmer could possibly sink.

Sometimes we are interested in a bridge because it was an especially hard one to build. There are interesting stories about the ways in which men overcame difficulties. We are interested in other bridges because they are named for some celebrated men, or in memory of some great event. For example, when we go to the city of Washington we see the great Arlington Memorial Bridge over which the George Washington Highway passes on its way to Mount Vernon. We see also the bridge named for Francis Scott Key, the author of *The Star-Spangled Banner*.

Between Buffalo, New York, and Fort Erie in the province of Ontario, Canada, is the Peace Bridge. This was opened in 1927. It is named to celebrate the hundred years of peace between the United States and Great Britain.

The first bridges ever built were made of wood. As time went on, men learned how to use stone. Some stone bridges, built hundreds of years ago, are still in use. The oldest ones date back to the time of the Romans.

The ancient Romans were great soldiers, great road builders, and great bridge builders. They con-

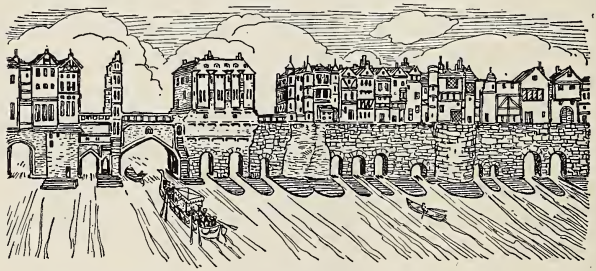
quered almost all of the world that was known two thousand years ago. Rome was the capital of their empire, and running out from the city in all directions, like the spokes of a wheel, were straight roads paved with heavy stone slabs. The Appian Way, which you remember reading about, is one of these. Wherever these roads crossed a river, the bridges were held up by arches. Each arch was built of stones carefully fitted together.

You have no doubt seen in parks modern arched bridges much like those built by the Romans. If you have never been told about the keystone in an arch, you should get your father to point one out to you. It is the stone at the center of the arch, at the top. It is the last one to be put in place, and it is shaped in such a way that it holds the whole arch together. If you take the capital letter W and black it over like this — — it looks very much like a keystone. This shape keeps it from being forced down between the other stones of the arch. The stones on each side of the keystone press against it and against each other, and so help to hold the arch up. If an arch has the right curve, and if the sides are built in the proper way, no weight that it is likely to carry will break it down.

When a Roman built a bridge, he was expected to keep it in repair for forty years, free of charge. Part of the builder's payment was held back until the end of that time, to make sure that he kept his agreement. We may be sure that Roman bridges were built honestly, for some of them are still standing, although they were built hundreds of years before

Columbus discovered America. You see them not only in and near the city of Rome, but in other parts of Italy, and even in France, Spain, and Portugal, which were parts of the Roman Empire.

Hundreds of years later, the people who lived after the Romans used the same ideas in bridge building. There were groups of men who called themselves "Brothers of the bridge." They made it their business to build new bridges and to keep old ones in repair, since in those days governments did not take charge of bridges.



London Bridge as it was about three hundred years ago.

In some old cities houses were built along bridges just as they are on streets. London Bridge has so many tall houses along both sides that once several of the houses broke the bridge down and fell into the water. Perhaps this is the reason for the old song, "London Bridge is falling down." Today in Florence, Italy, there still stands a bridge that is lined with the shops of goldsmiths and jewelers. You have probably seen a picture of it, for artists are fond of painting it. The Italian name for this

bridge is Ponte Vecchio, which means the old bridge.

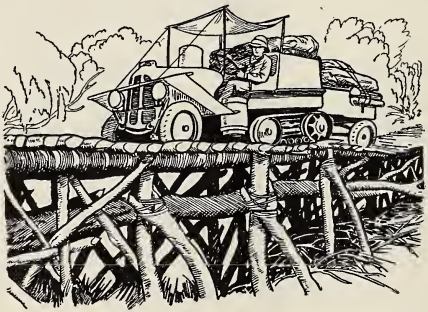
Many of the modern bridges in Europe are built on stone arches just as the old ones were. But the longest ones are either suspension or cantilever bridges like those in America. There are also modern arched bridges built of concrete. In these, of course, there are no keystones, since they are not built up stone by stone. The whole bridge is a solid mass of concrete, arches and all, like the Hell Gate Bridge or the Key West Viaduct.

Viaduct is the name usually given a bridge that carries a road or a railroad over a valley. There are many among the Alps in Switzerland. Some viaducts carry roads across other roads on lower ground. There may be one near your home town.

Wherever men build modern roads and railways, they build modern bridges too. Today, even in the heart of Africa, where there used to be only bridges of the simplest sort, many great steel bridges have been built. In many parts of South America, too, builders from the United States and Europe are putting up the same sort of bridges that are everyday sights at home.

Before the people who live in these distant places learned about modern methods, they had to get along with the materials that they found close at hand. They followed the methods that had been used for many, many years. You would never suppose that they could use the things that they did. Many rivers are crossed by bridges made from growing vines that hang from great trees leaning across the river. For other bridges the natives used ropes

made of fibers and hung them from branches of trees on both sides of the river. Such bridges are usually V-shaped. At the bottom there is a foot-path of planks laid end to end, and at the top are two ropes spread apart by crosspieces. A man steadies himself by grasping these ropes with his hands as he walks across the bridge. When a wider road for loaded animals was needed, it was made by tying logs close together and floating them on the water.



A native bridge in Africa. The truck is the kind known as a caterpillar tractor.

In some places a sort of rope toboggan slide was built, with one end much higher than the other. A man sits in a loop of rope or leather and holds on to a ring which slides down a rope. Thus he is carried across a river or a valley. When he wants to go back, uphill, he is pulled by a rope fastened to the ring. In some places the natives pull themselves each way by climbing like monkeys, hand over hand.

Sometimes, instead of being hung high above the

water, the bridges float upon the surface. Rafts or boats are fastened together side by side, and plank roadways are laid upon them. Bridges built of boats are called pontoon bridges. They are found on rivers in many parts of the world. There is a famous one across the Tigris River at Bagdad. It is opened twice each day to let vessels through, by floating aside some of the boats supporting the bridge.

China is a land that is full of rivers. The people there have always needed many bridges. Hundreds of years ago, they took pains to build fine ones. Marco Polo, who traveled in China about two hundred years before Columbus discovered America, tells about one of them. He says, "over a certain river there is a very handsome bridge of stone, perhaps unequaled by any other in the world. Its length is three hundred paces, and its width eight paces, so that ten horsemen can easily ride abreast. It has twenty-four arches, supported by twenty-five piers standing in the water, all of carved stone and built with great skill. On each side and from one end to the other there is a handsome railing formed of marble slabs and pillars. This serves to prevent accidents that might otherwise happen to passengers."

Between these pillars were many beautiful statues. At two places on the bridge were tall, heavy monuments. One stood on a huge marble tortoise and had a lion on the top. The other had a big stone lion standing near its base.

This bridge was very old even when Marco Polo saw it. We know also that in ancient times the

Chinese had many long roads, paved with stone slabs. Later, both the bridges and the roads were allowed to fall into ruin. The people grew careless and were satisfied to have only flimsy bridges. These were easily swept away by floods, for they were built on bamboo piles driven into the bottom of the river. The floors were made of matting laid on heavy bamboo stalks. There were also some pontoon bridges in China. Others were made by stringing several heavy chains across the river and laying planks on them.

In our day the Chinese are beginning to see that both roads and bridges should be strongly made, and that they should be kept in good order. They are learning to build modern roads, and wherever an important road crosses a river, they build a new bridge like those in our own country.

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Boys and Girls of Modern Days. C. S. Bailey.
Some of the stories are about Henry Ford, the Wright Brothers, and Colonel Goethals who built the Panama Canal.

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The Children's Book of Celebrated Bridges. L. M. Bryant.

Engineering Feats. Archibald Williams.
Chapter XVII. Bridges That Lift.

Victories of the Engineer. Archibald Williams.
Chapters IV–X. Bridges and Bridge-building.

TUNNELS AND FERRIES

Traveling among the Alps — Some American tunnels — How engineers make a tunnel — Where automobiles go under a river — Ferryboats — Ships that carry trains — All kinds of boats are used as ferries — The ferries of colonial days.

IF YOU have read *The Swiss Twins*, by Lucy Fitch Perkins, you know a good deal about the life of children in Switzerland. A longer story called *Heidi*, by Johanna Spyri, tells you even more. Perhaps you will visit this interesting country sometime, for Americans love to go there on vacation. In summer there are mountains to climb and wonderful excursions to make. In winter there is skiing, bob-sledding, tobogganing, and skating. In every season there are all sorts of story-book places to visit.

Switzerland, as you know, is a small country in Europe. It is surrounded by great mountains called the Alps. This name means pastures. It is well suited to these mountains, because there are many green grassy pastures far up on their sides as well as in the deep valleys. The Alps not only bound Switzerland on all sides, but they fill almost the whole country. Many of these mountains are so high that their tops are always covered with snow.

The Swiss people love their mountains, and often give them descriptive names. One, whose top is shaped like a priest's hood, they call The Monk. Another proud-looking mountain is named Rigi, which means the queen. A very lovely one is the Jungfrau, or young maiden. Perhaps you have seen pictures of these or of the mountain called the

Matterhorn, the highest of all the Swiss Alps, which is pointed like a horn.

When you go into Switzerland, or out of Switzerland, or travel about in Switzerland, you find many different ways of transportation. In some places ordinary railroads go through the valleys. In others, railroads of a special kind wind over the sides of mountains that are not too steep.

The locomotives have two kinds of driving wheels. There are the usual kind, and also one with cogs along the edges. While a train is running along a level track, this wheel is not doing any work. But when the train starts to climb, the engineer moves a lever like the one that shifts the gears in an automobile. This lowers the cog wheel a few inches so that its teeth fit into the notches in a third rail which runs along the center of the track. The cog wheel and its track work together to push the train along much as the two cog wheels in an egg beater make its blades turn. A railroad of this sort has the name rack and pinion. There are several of them on mountains in our own country.

Sometimes the Swiss trains go through tunnels cut right through a mountain. Above the tunnel there may be as much as a mile of solid rock. Nearly all the locomotives run by electricity, because this works better on slopes than steam does, and because it does not make smoke in the tunnels.

These are wonderful high bridges or viaducts across valleys. There are also many fine roads for automobiles over the passes, as the openings between the mountains are called. These roads always hunt out

the easiest slopes. They twist and turn, always climbing a little higher. There are many hairpin curves, shaped like a U, and as your automobile climbs up, you can look back and see the zigzag road, like a narrow ribbon, far below you. Sometimes you may count as many as a dozen stretches of road over which your automobile has passed. Everywhere there are interesting views, wonderful colors on the snowy mountain tops, waterfalls, and forests. There are pastures with grazing cattle, and quaint villages whose wooden houses have heavy stones on their roofs. Can you explain this? There are rushing rivers, and smooth, clear lakes which reflect everything like a mirror. Switzerland is full of beautiful pictures.

If we go into Switzerland from Italy, we are likely to take a train through the Simplon Tunnel, instead of riding over the pass. This is the longest tunnel in the world, more than twelve miles from one end to the other. It took more than seven years to build, for it had to be blasted through solid rock all the way. The men had to struggle not only with the hard rock, but also with streams of hot water that they found inside the mountain. It took them nearly six months to go the last three hundred yards.

There are really two tunnels, side by side. One is for trains coming from Italy, and the other for trains going to Italy. This is so that if a train should be wrecked on either track, it would not block the other. At first only one of these tunnels was finished, because the World War delayed the work. Finally, sixteen years after the first tunnel was begun, trains

were run in the second. Each tunnel slopes up a little toward the middle instead of running perfectly level from one end to the other. This is so that any water that may find its way in can be drained away downhill.

We can ride through the Simplon Tunnel in twenty minutes or less, but if we were to go over the Simplon Pass which climbs the mountain overhead, it would take our automobile about the whole afternoon. You can see how much time the tunnel saves, not only for people, but also for goods brought from Italy.

Other tunnels in Switzerland make travel easier than the routes over the high passes, and shorten the time needed for journeys into France and Austria. The St. Gothard Tunnel is nine miles long. It circles around inside the mountains and finally comes out almost exactly above the point where it entered. All the winding was necessary because a straighter slope from the entrance to the upper end would have been so steep that trains could not be hauled up the track.

The longest tunnel in America is the new one through the Cascade Mountains in the State of Washington. This is almost eight miles long. It is perfectly straight and the grade is very slight. It was built by the Great Northern Railway, and after nearly three years' work was ready for use in 1928. This tunnel saves long hard hauls over steep slopes, and of course saves many hours in the running time of trains. Before it was built, the tracks in several places were always in danger of being buried under heavy snow slides. For many miles there were

strong fences alongside the tracks to keep the snow from piling up on them. Now these fences are not needed, and passengers are in no danger of being held up by snow slides.

In South America there is a tunnel up among the summits of the Andes Mountains. This one, on the Trans-Andean Railway, which connects Valparaiso with Buenos Aires, is famous not for its length, which is only about five miles, but because it is the highest tunnel in the world. It is nearly two miles above sea level. When we think of the loftiest mountain we know, we get some idea of how high in the air this tunnel is. When we are told that this part of the Andes Mountains is covered with snow all the year, and that there are many frightful blizzards, we realize what hard work it was to build not only the railroad but especially the tunnel. It took an army of brave men several years. The work was well worth while, however, for it has made neighbors of countries that used to be separated by a great chain of mountains.

Perhaps you have wondered how the men digging a tunnel can tell where they are coming out. It is easy enough to start the digging, of course, but after they get inside a mountain how can they tell whether or not they are going in the right direction? Usually when men dig a tunnel, they begin not at one end, but at both ends, often miles apart. We think it wonderful that they can make the two parts of the tunnel meet. But if we should say so to one of the builders, he would probably say, "Oh, no. We have ways of measuring so carefully that before we start

we know that each group of men will dig straight toward the other. We should be very much surprised if they did not come together at the middle of the mountain."

Some tunnels go into a mountain rather low on one side, and leave it much higher up on the other side. Inside the mountain the tunnel works upward by making several loops, one above another somewhat like the curves in a corkscrew.

In some places tunnels have been built without blasting through solid rock. Under the East River in New York City are a number of immense tubes through which electric trains run. Some of these were built on dry ground little by little and then lowered to the bottom of the river. The builders bolted together a number of cast-iron rings, each more than twenty-one feet across, until they had pieced together quite a length of the tube. Then they used a special kind of boat to float one section after another out upon the river. Last of all they sank each section at its proper place and fastened them all so tightly that no water can leak in. When we ride through these tubes, we find it hard to believe that we are way down under water, for everything seems much the same as in a subway or a tunnel through a mountain.

The newest tubes in New York are for automobiles. They are under the Hudson River and were built in still another way. At the bottom of the river is a layer of soft silt, or muddy soil. Through this the tubes were built by the use of what is called a boring shield. Perhaps you know the little mouse-like

animal called a mole. He lives underground and plows tunnels through the soft earth under a lawn. The shield that the builders of the Holland Tubes used bored along in much the same way.

Here is an explanation of how it was done. If you take an ordinary drinking glass, lay it on its side with the bottom in front, and push it into a pile of sand, you will see how a boring shield works. The ones used in building the Holland Tubes were immense things, more than thirty feet across. They were pushed forward by machinery, two feet or so at each push. Then a great iron ring would be set up just inside the tail end of the shield. The whole length of the tube was built up in this way, one ring at a time, each firmly bolted to the others.

It took eight years to finish the Holland Tubes. There are two of them, running side by side. Each is 9250 feet long — almost a mile and three quarters. There are two roadways in each tube, one for fast-moving cars, and the other for trucks and other slower cars. You go from New York to Jersey City through one tube, and come back through the other. In the line of fast-moving cars we can travel through the whole length of the tube in about six minutes. If we prefer to go on foot, we can do so on a sidewalk, raised a little above the roadway. The tunnel is brightly lighted, and the air is changed several times every minute so that it is always fresh. There are signals that help to avoid accidents, and policemen to help if anything goes wrong.

Now that these wonderful tubes are in use, the thousands of people who go to New York every day

on business get to their homes and offices very easily. There are no more long lines of cars at the ferry landings waiting to drive aboard the crowded boats. On some days as many as 52,000 cars use these tunnels during the twenty-four hours.

Very often, instead of burrowing under a river to build a tunnel for trains or automobiles, boats are used to ferry people and goods across. How many kinds of ferryboats can you tell about? If you have been in New York, probably the first ones you think of are the big broad double-ended steamboats in the harbor there. All day long they hurry back and forth in all directions. There are so many of them that we wonder why they do not get in the way of other vessels, but they hardly ever do. They never have to turn around, for they have a pilot house at each end. It is easy to stop or to start them quickly, for they have propellers at each end too.

One of the crowded ferryboats in New York harbor.

These ferries make trips all day long and until late at night. Almost always their upper decks are

crowded with men, women, and children. Some of them carry automobiles and wagons. Their lower decks are made into several wide roadways into which vehicles can be driven directly from the wharf. As each automobile or wagon goes aboard, its driver is told whether to join one of the inside lines or an outside line. This is to keep the boat well-balanced.

Until about fifty years ago, when the first bridge was built, ferries were the only way of crossing New York Harbor. Nowadays there are many bridges and tunnels, yet great numbers of people prefer the boat ride. Which would you like better?

If you were to go to San Francisco by train from the eastern part of our country, you would leave the cars at Oakland. You would cross San Francisco Bay on a ferryboat. This saves time because the distance across by water is much shorter than the train ride around the bay. In a few years the bridge between the two cities which is now being built will be finished. Probably, however, there will always be ferryboats that carry people, sometimes in their automobiles, between San Francisco and the cities across the bay. At present 50,000,000 people pass through the Ferry Building in San Francisco every year.

There is a huge ferry that carries trains on Lake Michigan, large enough to carry thirty freight cars and two locomotives, and strong enough to break through the ice that sometimes blocks the harbors of this great fresh-water lake.

In the harbor of New York you may perhaps see a special kind of ocean-going steamship which in one way is a ferryboat. In another way it is a freight liner. It carries loaded freight cars, as many as a

hundred at a time, all the way to Havana. There are two of these ships, or seatrains as they are called, that sail from New York, and there is one that travels between New Orleans and Havana.

The seatrains work in this way. When a ferry-boat or a scow is used to carry a few cars at a time across a harbor, the cars are run right on to the vessel from tracks on the wharves. When the ship named Seatrain New York or Seatrain Havana takes on her cargo of cars, however, they are placed aboard quite differently. Huge cranes pick up the cars, one at a time, and lower them into the ship, where they stand on tracks laid on the decks. There are four decks, with tracks enough to hold a mile-long train.

It takes about three minutes to handle each car. The whole ship can be filled in about ten hours. At the end of the voyage she can be emptied again just as quickly. This saves a great deal of time and money. If everything were to be taken out of the cars and moved into the holds of ordinary freight steamers a little at a time, the work would take a week or more.

In places, little steamboats or motor boats or even common rowboats are used when only a few people at a time wish to cross the water. When horses, automobiles, and trucks have to be taken across, a big flat-bottomed boat is used. It has a long wide deck, with the sides fenced in. There is an engine to run it.

On narrow rivers or lakes, the ferry is sometimes worked by a chain which reaches from shore to shore. A machine in the boat pulls on this chain, much as a man pulls hand over hand on a rope. Little by little

the boat is dragged across. A ferry like this has one special advantage; the chain keeps the boat from missing its landing place when the water is rough or in foggy weather.

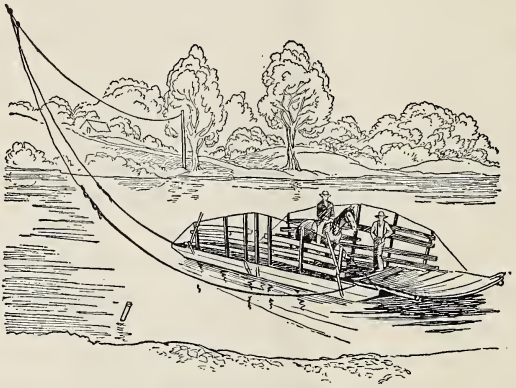
Ferries of a still simpler sort are used by the natives in far-away corners of the world. In India and China cattle skins, blown full of air like the floats for rafts that are told about later, are used to ferry a man or two at a time across a river. They were probably invented longer ago than canoes, dug-outs, or rafts. To ride one of these must be something like riding an inflated beach-ball across a swimming pool.

In colonial days the settlers used to hire Indians to ferry them in their canoes across narrow stretches of water. A school teacher, who traveled on horseback from Boston to New York a little more than two hundred years ago, felt very timid when she came to a stream and found that she must cross to the other side in a frail birchbark canoe. "It was very small and shallow," she wrote in a letter. "I sat with my two hands holding the sides and looked straight ahead. I dared not so much as move my tongue a hair's breadth more on one side of my mouth than the other. A very little thing would have overturned us." She worried, of course, more than she needed to.

If a coach came to a stream which was too wide to be forded, or dragged through, its wheels were placed in two canoes side by side, and paddled across. The horses had to swim.

In later years, when settlers began to make farms along the rivers, they built flat boats to use as ferries. Each farmer had his own. When Washington crossed

the Delaware the night he surprised the Hessians at Trenton, New Jersey, he found boats like these very useful. There were many of them tied up at landings near-by, and Washington borrowed them to carry his army across the river.



What old-time American ferries were like.

It was near Trenton that some of the first public ferries in our country were set up. They used big scows open at both ends so that horses and carriages could be driven on and off. Some of the scows were pulled across the river by a rope, and others were pushed by poles long enough to shove against the bottom. Even today, in some parts of the country, you may find ferries working in this same way.

WHAT TO READ

Engineering Feats. Archibald Williams.
Chapter V. Tunnelling the Alps.

Victories of the Engineer. Archibald Williams.
Chapters II. Train Ferries; XIX–XX. Tunnels and Tunnelling.

Long Ago and Far Away

MAN'S MOST USEFUL INVENTION

How the wheel was invented — The discovery of spokes for wheels — How tires came to be used — Pneumatic tires — Wheeled vehicles of ancient times.

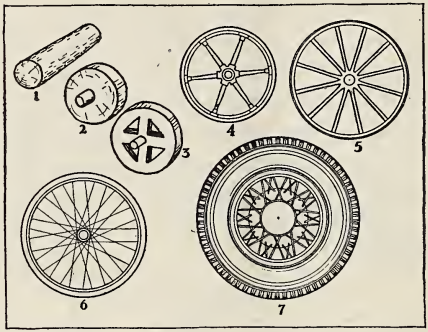
SUPPOSE you were asked, "What is the most important thing man has ever invented?" What would you answer? You might say, "The steam engine," or "The airplane," or "Radio." All these are among the most wonderful inventions, but if you go back nearer to the beginning of man's life upon the earth, you will have to name something else.

The answer to this question is already given on this page. It is such an everyday thing that until you think carefully, you will not see why it is so wonderful. There are good reasons, however, for choosing the wheel as the answer. Here are some of them.

First of all, think of the many ways in which travelers depend upon wheels. Can you imagine a world in which there were no automobiles, no trains, no steamships, and no flying machines? How could anyone travel, or how could anything be sent across either land or water in the fast and easy ways we know without some kind of wheel? If the wheel had never been invented, the roads of today would be no better than the first rough tracks worn by sledges in the early days of the world.

Now think of other uses of wheels. Houses could not be built if there were no wheels, for everything that is used in putting a house together is made by

machines that use wheels. The clay from which bricks are made could not be mixed unless wheels turned the machine. Mortar is ground under heavy wheels. Lumber is cut by circular saws, which are really wheels with teeth along the edge. Wall paper is printed by rollers which turn like wheels. Rollers of another sort are used in making window glass.



How wheels have been improved.

1. The roller. 2. The first axle. 3. How spokes began. 4. An Egyptian chariot wheel. 5. A wooden carriage wheel. 6. A bicycle wheel. 7. An automobile wheel of today.

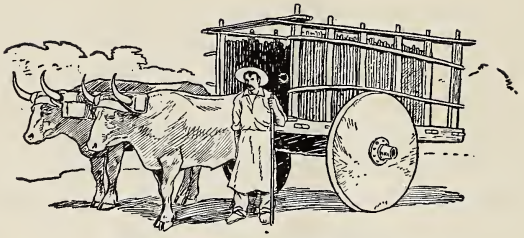
The cloth in our suits and dresses is woven by looms in which wheels play a necessary part. In making dishes a potter's wheel has to be used. Clocks and watches will not go without wheels. Printing presses work by wheels and rollers. Books and newspapers would be much more expensive if thousands of years ago someone had not happened upon the idea of the wheel.

How were wheels invented? Probably very early in the history of mankind something like this hap-

pened. A man was trying to move a heavy load along the ground. By accident, a piece of a branch of a tree got under his sledge. The man kept on pushing or pulling, and suddenly his load ran forward a little distance quite easily. The round branch rolled out behind his sledge, and perhaps the man saw that this little piece of wood had helped him for a moment. After this he doubtless used a roller under every heavy load.

Rollers are still used in this way. You may have seen someone at the beach moving a dory down to the edge of the water. This kind of boat has a flat bottom, and no one could possibly drag it over the sand unless he put a roller under it. Then the work is quite easy, except that someone must keep picking the roller up after the boat slides over it so that he can run ahead and put it under the front end again.

The next step in making wheels came when some man, ages ago, thought of fastening the roller to the bottom of his sledge. He wanted it to keep turning without rolling from under the sledge. After a good many trials and failures, he found that the best way was to cut two rather thin slices from the end of a log, just as we cut slices from a loaf of bread. Each slice was loosely pegged to a sort of axle, and the axle was fastened across the bottom of the sledge. Now the man had a cart with two real wheels which turned. The trouble came when he tried to go around a corner. But as time went on, man learned that he should fasten his axle at only one point, the center. Then not only did the wheels turn as the load was drawn along, but the cart could be steered.

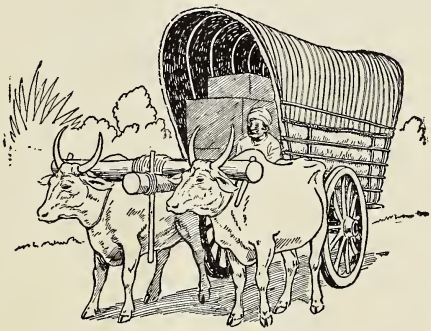


An ox cart of South America.

The first wheels were solid pieces of wood, without any spokes, since they were simply slices of a log. Men found that they broke easily. If we look at a thin circle of wood cut from the branch of a tree, we see many little dots in it. They make what is known as end grain. If the circle of wood is about an eighth of an inch thick, we can break it quite easily, just as we break pieces out of a cooky. That is what happened to the first wheels. They were wrenched sideways, and they ran against boulders. Pieces were broken out, and there was nothing to do but cut a new wheel from another log. This must have been terribly hard, for the earliest men had no tools except knives and axes made of flint.

So men studied out a way of making wheels that would not break so easily. Planks were cut through a log lengthwise, or with the grain instead of across it, and were fastened across the slice cut from the log. Men discovered that this added a great deal of strength. We find this same idea used today in those countries where wheels of solid wood are still used.

The invention of spokes was another step ahead. The solid wheels were very heavy and clumsy. Someone thought of cutting out pie-shaped pieces of wood all the way around. This left a hub at the center, spokes running out from it, and a rim around the edge. It was found that wheels made in this way were just as strong as solid ones and very much lighter. But it was a great many years before anyone discovered how to build wheels out of several pieces of wood, some straight and some curved, as wheels are built in most countries today.



A freight wagon of the East Indies.

The earliest wheels were made without any tires. There was only a solid rim of wood. On rough ground these rims wore out very fast. Perhaps it was five thousand years, though, before men learned how to make strips of iron, bend them, and nail them on the rims of their wheels. This, of course, made the rims wear longer. Then after some five thousand years more, tires made of solid rubber were invented.

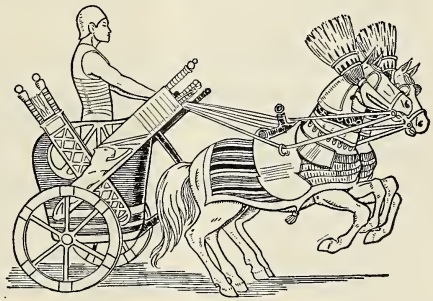
These made carriages more comfortable, and also made it easier for horses to draw them. Finally, not so very many years ago, the best tires that people believed ever could be made came into use. They were like a piece of garden hose cut lengthwise. The two edges were cemented tight to the rims of the wheels. The tire had a little space full of air in the center, and this made a sort of cushion. People who rode on these tires thought them very springy, but we should doubtless think them much too hard.

The last improvement in tires came when pneumatic tires were invented. Everyone knows what they are like. They are the kind now used on bicycles and on automobiles. The secret of their comfort is that they are filled with air.

An automobile tire has a thick shoe made of rubber and heavy cloth, and inside that a round tube of thin rubber. This tube is pumped full of air, until it is as firm as a tennis ball. There is no way for the air to get out unless we have the bad luck to get a puncture by riding over a sharp nail. Even very heavy weights can be carried on pneumatic tires, as you know from the many great trucks and busses you see. These tires not only make it possible to ride over rough places comfortably, but they cause less wear on roads and on automobiles than any other kind of tire.

You will find it interesting to look up pictures of wheeled vehicles down through the ages. These will show you in how many ways wheels have been made at different times, and how greatly they have been improved in recent years.

The oldest wheeled vehicles of which we have pictures are the chariots of the Egyptians. You have no doubt seen these in history books, which copy them from paintings on the walls of tombs and temples built nearly four thousand years ago.



An Egyptian chariot.

In the Museum of Fine Arts in New York City there is a real chariot that was probably made at about that time. Later the Greeks and the Romans learned to make chariots of the same sort. You may have seen copies of these in the races at the circus. When you read the story *Ben-Hur*, by Lew Wallace, you will find an exciting account of a chariot race in Rome. In the Bible you will find mentioned the chariots of the kings of those days.

A chariot must have been easy to fall out of, especially if the horses were going fast. It was nothing but a little platform set on the axle between two small wheels. It was big enough for two men. Perhaps you remember the width of a standard railroad gauge. The wheels of ancient Roman chariots

were that same distance apart. It has been the width between the wheels on most vehicles from that day to this.

The floor of the chariot was not more than two feet above the ground. The front was about as high as a man's waist, while the sides were a little lower. The back was open.

A chariot was drawn by several horses, either two, three, or four, all harnessed abreast. It was almost always driven as fast as the horses could gallop. Chariots were sometimes used in fighting. Then the reins were long enough to be tied around the driver's waist, so that he could use his hands for throwing spears or shooting arrows. A war chariot often had sharp sword blades sticking out from the wheels. You can imagine how many enemies would be cut down when a chariot dashed through their ranks.

There were no seats in a chariot. The driver stood up, and the other person might brace himself against the rim of basketwork along the side. Most chariots were made of wood, but in some the floor was a network of rope to give something a little springy to stand on. Other chariots were made of bronze — platform, sides, wheels, and all. Some were painted in bright colors and some had ornaments of brass or bronze. A lady might have one with a sort of umbrella over her head.

The Roman emperor's chariot was made of ivory, decorated with gold. It was open at the front instead of at the back. Most of the time four splendid white horses were harnessed to it, but at a great festival it was often drawn by lions, tigers, leopards,

or even bears or elephants. A Roman festival was called a triumph if it was held to celebrate a victory in war. Then the prisoners were chained behind the chariot while it was driven slowly along in the procession. Would you like to have been there to see such a Roman festival?

WHAT TO READ

Ancient Man. H. W. Van Loon.

How They Carried the Goods. C. G. Muller.

Chapters I. The Stone Pyramid; III. Solomon and the Queen of Sheba.

Man the Miracle Maker. H. W. Van Loon.

Chapter V. "From Foot to Flying Machine."

The Story of Mankind. H. W. Van Loon.

With a list of historical reading.

The Story of the Wheel. G. M. Boumphrey.

Beginning with the cave man's roller and ending with the automobile.

"Whence the Wheel?" D. P. Dobson. *Home Geographic Monthly*, vol. I, no. 8, Feb. 1932.

OLD-TIME AMERICAN CONVEYANCES

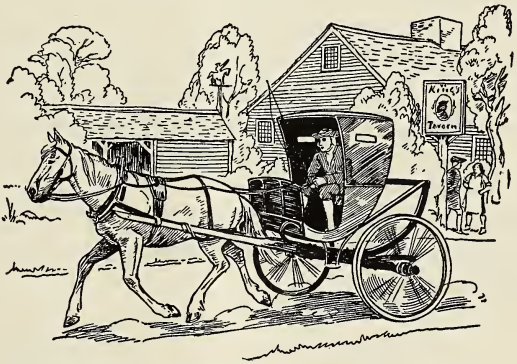
The carriages the colonists rode in — George Washington's carriages — Traveling by stagecoach — In the days of the covered wagon.

SOME of the first wheeled vehicles mentioned in American history were called chariots, although they were not very much like the chariots of the ancient Romans. Another name for them was chair, perhaps because people thought they looked something like the sedan chairs which were in use at that time and which we shall read about in another chapter. Still another name for small two-wheeled carriages used in the colonies was chaise, which is a French word meaning chair. It is pronounced "shaz." Sometime you will enjoy reading a very amusing poem by Oliver Wendell Holmes. Its title is "The Deacon's Masterpiece." It tells how a one-horse chaise was built, and how it finally fell to pieces.

Perhaps the commonest name for these little carriages was gig. This is an old word given to anything that whirls or moves rapidly and easily. Gigs had two wheels, quite wide apart, with broad tires. This kept them from getting stuck in the mud. The seat was wide enough for two people. In front of the seat, almost over the shafts, was a narrow seat for the driver. A gig had no springs, but was hung on strong leather straps that ran between the front and the back of the frame. This kept the carriage from jolting as it would have done if it had been set right on the axle. In those days springs like ours had not been invented.

Most people liked to have their gigs gaily painted,

so the wheels were most often blue or brown, while the body of the carriage might be red or yellow. There was a folding top, or hood, of leather.



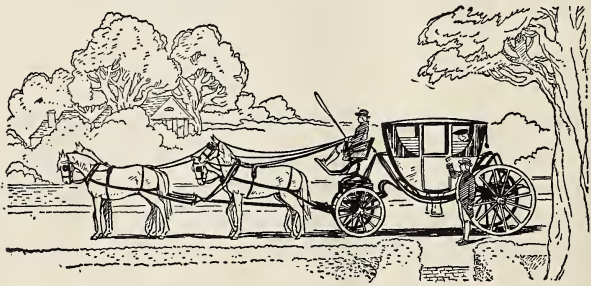
A one-horse chaise.

Many gigs were in use at the time of the American Revolution. George Washington had one, with a seat just wide enough for one person. He drove himself, but at the back of the carriage was a little seat for the Negro boy who always went along to open the gates and hold the horse while his master was visiting at someone's house.

Next after gigs came coaches. They were not used, however, until much wider roads were built, for coaches had four wheels and so needed more space than carriages with only two wheels. In the large towns in the colonies, many of the rich people owned coaches. They were usually brightly painted. Red, yellow, or blue were favorite colors for the bodies. The wheels were usually brown, for even the

best streets were muddy in wet weather, and brown showed the mud least.

After he became President, George Washington had a beautiful coach, the finest in the country. In this he made his long journeys. It was painted white, and the framework and springs were plated with gold. On the front, the back, and the sides were pictures showing the four seasons, spring, summer, autumn, and winter. Washington's coat of arms was on the two doors. There was glass in the windows, and there were shades that could be pulled down when the sun was too bright. The seats were of padded leather.



George Washington's coach.

This coach was drawn by four white horses. Alongside, on other white horses, rode two men in bright uniforms of red and white. The coachman, or driver, also wore these colors, and so did the footman who sat beside him except when he sprang to the ground to help the President alight.

Behind the coach followed a light wagon carrying

baggage. Also in the company were four servants on horseback and Washington's own saddle horse, so that he might ride when he wished.

How differently the President of the United States travels today! The old-fashioned ways would never do now, of course, but they sound to us much more interesting than automobiles and trains.

As our country grew, lines of stagecoaches like those in England were opened for people who wished to travel. Do you know why stagecoaches were given that name? In the old days, a stage was the part of a journey made between the places where the horses were changed. Usually a team of either four or six horses would be harnessed to the coach at the starting point and would travel as fast as they could for about ten miles. This was the first stage of the journey. Then fresh horses would be put in their places, and they would draw the coach ten miles more.

Traveling was done only by daylight. If passengers had to spend the night on the road, they stayed at the inn or tavern at the end of the last stage for that day.

The first stagecoaches in America began to run between large cities in the eastern colonies a few years before the beginning of the War of Independence. There was a famous one named The Flying Machine which was thought to travel very fast indeed. It took almost two days, however, to go from New York to Philadelphia. We can now make this trip by train in about two hours.

The first stagecoaches from Boston to New York

spent nearly a week on the road. If a Boston man wished to spend Christmas in Savannah, Georgia, on what day do you suppose he would have had to start? It would have been not later than December second, for the journey took a little more than three weeks.

These first stagecoaches were nothing but big wagons. They had straight sides, and a rounded top which was made of heavy cloth. It was several years before any had leather curtains along the sides to keep out wind and rain. It was many years more before any had glass windows. Inside the coaches were three or four wooden benches running from side to side. Each had seats for three people. Passengers had to climb over the front benches to reach the others. There were no backs to the benches and no springs on the coach. Think what an uncomfortable, jolting ride the passengers must have had. How they must have ached after even a few hours!

By and by someone thought of nailing boards or strips of leather along the benches as backs. Next, iron springs were placed under the seats, or else they were held up by long leather straps. Even then the passengers rocked and swayed in a very lively way.

The men who managed the lines of stagecoaches painted them in bright colors, for they seemed to think more of making them look gay than of giving the people who rode in them an easy journey.

It is interesting to know that the best stagecoaches used in crossing the Western prairies were built in a New England town, Concord, New Hampshire. The body of a Concord coach was shaped more or less

Before the days of railroads, old-time stagecoaches used to carry passengers and their baggage from one town to the next. The starting point was usually a tavern.

like a football. The passengers had to climb several steps to get in. It could carry fourteen people, nine of them inside and five, counting the driver, outside. There were three leather-covered seats inside, each with space for three passengers. On one of them people had to sit facing the back. There was glass in the windows and in the panels of the doors. The windows had leather curtains too. Sometimes a sort of belt passed across in front of the seats to keep people from being pitched out of their places by rough spots in the road. From the roof hung loops of leather to which people clung when the going was the worst.

The roof was nearly flat, and there was a metal railing around it. Here was piled the baggage, covered over with a big sheet of leather, called the boot. On the roof, too, at the front was the bench for those passengers who rode outside, and in front of them, lower down, was a seat for the driver. Under this was another boot in which mail and valuable express packages were stored. At the rear of the coach was a rack for still more baggage. There were four heavy wheels, with wide tires. The color of a Concord coach was usually yellow, with brown or black trimmings.

Many of them were named for great characters in history. There was the Columbus, the Washington, the Lafayette, the Queen Victoria, and even one named for Pocahontas.

A ride in one of these stagecoaches was likely to be an exciting experience. Sometimes they were attacked by Indians or by highwaymen. Often the

roads were deeply rutted and full of mudholes. When the driver saw a rough place close at hand, he would shout out, "Now, gentlemen, to the left!" or, "Now, gentlemen, to the right!" He would guide the horses over the smoothest part of the road, while everyone in the coach threw his weight to the side the driver named, hoping to escape an upset. Now and then a wheel would be wrenched off, and the coach would topple over. Once in a while there would be so deep a mudhole that the horses could not drag the coach through until all the passengers lightened it by climbing out. A coach might come to a bridge that had been broken down by some heavy wagon. Then the passengers were floated across the stream on a raft. The horses were unharnessed and made to swim, while the heavy coach was dragged from one bank to the other by a long rope. Everyone tugged, men as well as horses. Probably everyone and everything was pretty well soaked with muddy water before the coach could go on its way again.

In New Hampshire, there were three kinds of tickets on some of the stagecoaches. First class fare was $7.00. Second class was $3.00. Third class was $1.50. All classes occupied the same seats, but when the stage came to a steep hill, the driver shouted: "First class passengers, keep your seats; second class passengers get out and walk; third class passengers get out and push."

About seventy-five years ago a line of stagecoaches ran all the way from a little town near the center of Missouri, where the railroad ended, to San Francisco.

The route could not be very straight because it had to follow the route where the going was least rough. The whole distance was 2795 miles, and it took nearly twenty-five days to cover it. Can you find out how long it takes a railroad train today?

A six-horse stagecoach, used in the West before the days of railroads.

There were no roads, and everywhere it was heavy pulling for the horses. In rocky or sandy places they could go no faster than a walk. There were a few smooth stretches where the horses could gallop. Most pictures that you see show the Western stagecoaches swaying and tossing, with the horses going at a run. It would be more true to life if they were shown plodding along slowly, pulling with all their might.

We come now to the story of how the early settlers moved from our Eastern States into the western part of the country. Imagine that you were a girl or a boy belonging to a family who were doing this eighty or ninety years ago. In those days there were no railroads across the continent, and there were no smooth highways with comfortable, speedy automobiles rushing over them.

You traveled in a heavy covered wagon drawn by six horses or perhaps by two or three yokes of oxen.

You might need five months in moving as far as from Kentucky to Oregon.

Nearly all the way the country was a wilderness, with no roads, no bridges, and no signboards to direct you. There were Indians to fight and wolves to drive off. There were immense herds of buffaloes that might block your way for several days.

Probably your father's wagon was one in a caravan of a hundred or more. This was because it would not have been safe for only one or two wagons to make the long journey alone. At night all the wagons were arranged end to end in a wide circle, with an open space in the center. This made it easier to defend the caravan if the Indians attacked it. The open space within the circle was made into a camp-ground. When the weather was pleasant, the people set up their stoves, cooked their suppers, and then rolled themselves in blankets and went to sleep on the ground. The men took turns in standing guard. On stormy nights, everyone ate and slept in the wagons.

Some of these covered wagons were filled with beds, chairs, tables, and stoves. The women and children who rode in them had to crowd in wherever they could. Other wagons were loaded with supplies and all the household goods that the families were taking from their old homes in the eastern part of the country. Any farm animals that a man owned followed along back of the family wagon. Men on horseback and armed with rifles rode ahead of the caravan, also behind it and along each side. They kept a sharp lookout for danger, and they all watched

to see that no wagons or animals got separated from the rest.

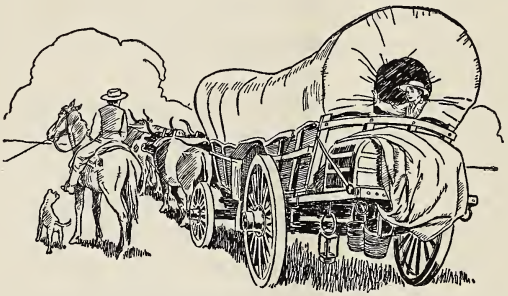
Year after year, one caravan followed another. The broad wheels of the wagons wore rough roads, leading some to one part of the West and some to another. You may be interested to find out whether any of the great modern highways follow in a general way any of the routes marked out by the covered wagons.

One name for a covered wagon was prairie schooner. Both the body and the white top were shaped a little like the hull of a sailing vessel. Another reason was that from a distance the top looked something like the sails of a schooner. Perhaps, also, this name was given covered wagons because they went on long voyages over prairies much as sailing vessels did on the ocean.

A covered wagon had a strong wooden body whose floor sloped upward both at the front and at the back. This was to keep the load from sliding out at one end or the other when the wagon went up or down a steep hill. The floor also curved in from the sides, something like the bottom of a canoe. This was to help the wagon float in deep water. The sides and ends sloped outward, to give more room for the freight. Underneath the wagon, and fastened to one of the axles, swung the pails used to water the cattle and the bucket of tar used to grease the wheels.

The four wheels were tall and strong, and had rims six or eight inches wide, so that the wagon could more easily be drawn out of deep mud. Many times on a journey overland a prairie schooner had to ford a

stream. Most times the water was so shallow that the horses or oxen could drag the wagon through. But when the river was deep and the current strong, the animals had to swim, and they and the loaded wagon would sometimes be swept down the stream and lost.



A prairie schooner, or covered wagon.

Prairie schooners were always painted in the same colors. The body was blue, rather lighter than the shade used in flags, and the framework and the wheels were red. The big canvas top was white. Why do you suppose these colors were chosen?

Besides their color, there was another way in which these wagons were all alike. Fastened to the collar of one of the horses or oxen was an iron hoop with from three to six bells around it. These bells were one of the pioneer's most cherished possessions. He was proud to arrive at the end of his journey with the jingling bells still on his team. You see, if he got stuck in the mud somewhere, and had to ask another wagon to drag him out, he was expected to give his bells to the man who helped him.

Perhaps you have heard someone who has been invited to a party say, "I'll be there with bells on." That is an old saying which may date back to the days of the pioneers. If a wagon kept its bells all the way across the continent, there was reason for its owner to feel happy. It showed that everything had gone well.

The top of the prairie schooner was held in place by six or eight wooden bows, which made high arches from one side of the wagon to the other. It was tied down with rope at the sides and ends. There was a round opening in the center of each end, just about big enough for a man to crawl through. This was easily made larger by loosening a rope when anything was to be unloaded.

There were several reasons for giving the top a curved shape. In the first place, a wagon with a rounded top holds more than one with a flat top. Also, it sheds rain better. And when the wagon had to be dragged through woods, the branches of the trees slid easily along the smooth curved sides and top.

Sometimes you may hear a prairie schooner called a Conestoga wagon. This is because it was in a valley in Pennsylvania bearing this Indian name that these wagons were first built. They were used for hauling heavy freight. Perhaps you have seen one of these old wagons in a museum. They were used in some places until about fifty years ago.

We should think a journey made in a covered wagon a very slow and uncomfortable one. The prairie schooners were, however, a great improve-

ment over the trains of pack horses that were used before these wagons were invented.

WHAT TO READ

The Conestoga Wagon. H. S. Hill.

The Highway and Its Vehicles. H. Belloc.
131 pictures, many in color.

How They Carried the Goods. C. G. Muller.
Chapter X. Marooned on the Oregon Trail.

How They Carried the Mail. Joseph Walker.
Chapter XIII. On the Overland Stage.

Stage Coach and Tavern Days. A. M. Earle.

ODD VEHICLES OF OTHER LANDS

Our neighbors to the south — An Irish jaunting car — The gay carts of Sicily — Carriages of Russia — A rough ride in China — Old ways and new.

WHEN we travel in foreign lands, we see many carts and wagons that look very strange to us. In countries where the roads are good, the people who can afford them use automobiles. In others, where the roads are rough and narrow, we see only old-fashioned vehicles like those used by the fathers and grandfathers and great-grandfathers of the natives.

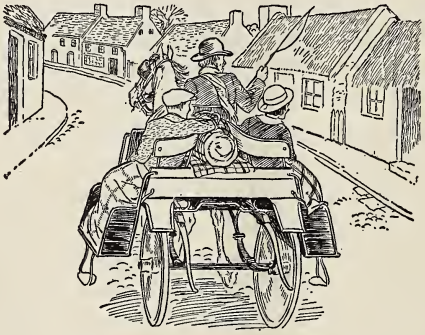
Mexico is a country where there are almost no good roads. There we often see carts with solid wheels made from slices of huge trees, just like the first wheels were made in the world. The drivers never use grease, and since the axles are made of wood, the wheels squeal and groan. These carts are usually drawn by donkeys, sometimes harnessed three abreast. For the heaviest loads oxen are used. We are told that the men who drive them like to have the wagon wheels squeal, because they believe that the noise makes the oxen work harder.

Wagons, more or less like the old prairie schooners, can be seen in various parts of the world today. They are used in South Africa, for example; also in Argentina and Brazil. Many of the wagons used in South America have only two wheels, but they are enormous ones — perhaps eight feet tall. Sometimes as many as eight or ten oxen are hitched to one of these wagons. Can you explain why?

If we went to Ireland, we should find people using an interesting little carriage very different from those anywhere else in the world. This is a jaunting car.

Our visit to Ireland would not be complete until we had a ride in one.

A jaunting car has two high wheels. There are two seats facing outward over the wheels so that the passengers sit back to back with their feet hanging out over the sides. In the middle, between the two seats the baggage is packed. There is one horse, and the driver sits in the front corner of one of the seats.

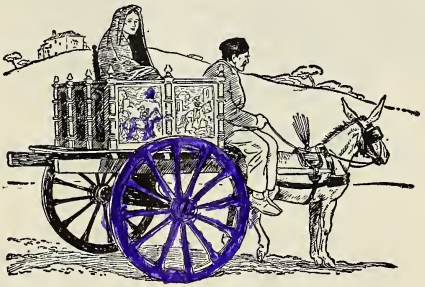


A ride in a jaunting car.

If we visited the island of Sicily, near the toe of Italy, we should see what are probably the most beautifully decorated carts in the world. They are so pretty that it seems a shame to use them for the hard work of the farms. The people are very proud of these carts, and keep them looking spick-and-span. They are a family's most prized possession, and often are handed down from father to son for many, many years.

A Sicilian cart is most often painted yellow, about the color of a lemon. On the sides may be pictures

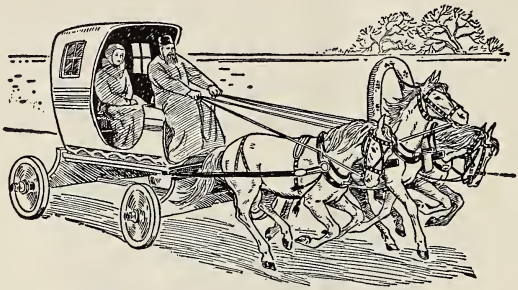
of flowers and fruits, or of Bible stories, or scenes from history. These are in bright colors, red, blue, green, and orange. The wheels, axles, shafts, and sides are carved or painted with scrolls. The horse or donkey has a gay harness, sometimes decked out with bouquets of flowers, and sometimes with bunches of roosters' feathers that stand two or three feet above his back. He may have another bunch on his head, too.



One of the gay carts of Sicily.

The animals that draw these little carts trot along very quietly. The horses that draw Russian carriages seem much livelier. The usual way of harnessing them is three abreast. It is very exciting to see a troika, as the Russian traveling carriage is named, come dashing along a rough country road or through the crowded streets of a city. We may be sure that the driver is very skillful. Of his three horses, the two outside ones are galloping, and the middle one, between the shafts, is trotting. They seem to be doing their best to make an interesting picture. The outer horses hold their heads low and turned a little

to the side. The one in the middle holds his head very high, while over his neck is a big wooden arch which connects the two shafts.

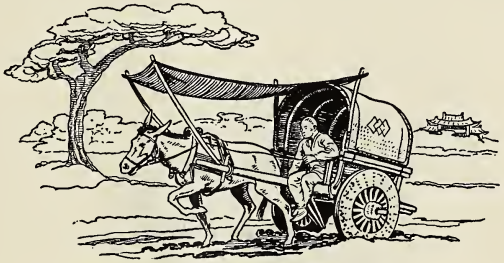


An old-fashioned Russian troika. The name comes from a Russian word meaning three.

Russian wagons and carriages have to be very strongly built, for the roads are often rough and muddy. Some wagons have wheels seven feet tall. Can you think of a reason why this is a good plan?

The northern part of China is another part of the world where we are quite likely to have a ride in a queer vehicle. These are two-wheeled carts drawn by donkeys, mules, or small horses. There are no seats, so passengers have to sit cross-legged on the floor. The driver sits out on one of the shafts. The carts have no springs. Their wheels may be large and heavy, or so small as hardly to reach to a man's waist. They always have many more spokes than the wheels used in other countries. The rims of the wheels are studded with heavy nails.

Someone has said that even on a fairly smooth road, a traveler can be sure of a very rough, uncomfortable ride. Carts like these have been used in China for more than three thousand years. They began to be used as far back as the chariots of the Romans, and perhaps earlier.

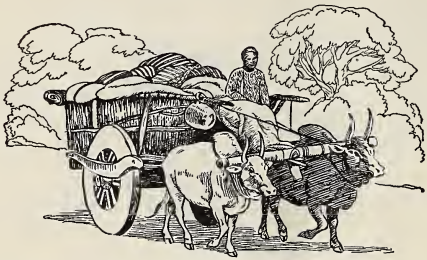


A common conveyance in China.

Besides these vehicles just described, we should see many more strange ones if we should take a trip around the world. In many parts of the world we should find a surprising mixture of old and new ways of transportation.

In cities on both sides of the globe we should see men and women carrying loads on their backs. Farther along the street might be a sledge like those used before wheels were invented. Across the way we might see a solid-wheeled wagon of the sort made before men knew how to make spokes. Here would be a carriage, there, an electric street car. A few automobiles would be taking passengers to a railroad train about to start out of the city. Now and then an airplane would try its wings.

Some of the people cling to the ways they have been taught by their fathers. Others have taken up those shown them by visitors from places where up-to-date methods are followed. It would be interesting to think out the reasons why in certain countries most of the people are quick to accept new ideas, and why in other countries they are slow to do so.



A heavy freight wagon of India, drawn by queer humped-back oxen or bullocks.

Can you find pictures of vehicles used in different parts of the world which are typical of their own country?

WHAT TO READ

How Other People Travel. E. A. Headley.
Chapters II. A Trip in Ireland; IV. A Ride in a Troika.

How the World Travels. A. A. Methley.
Chapters I. Travel in Olden Days; X. Strange Travel in Strange Lands; XII. Strange Vehicles of Europe.

"Queer Methods of Travel in Curious Corners of the World." O. P. Austin, *National Geographic Magazine*, vol. XVIII, no. 5, Nov. 1907.

"Sicily's Vanishing Medieval Peasantry." M. L. Law. *Travel Magazine*, vol. LII, no. 2, Dec. 1928.

VEHICLES THAT HAVE NO WHEELS

How the Indians made a travail — The Pilgrims and their sledges — The sledges used in cold countries — Dog sledges of the Eskimos — How dog sledges are made — How some Alaska Huskies saved a town — The reindeer of Lapland — A ride in a reindeer sledge — Where sledges are used in summer weather.

THERE are many kinds of beasts of burden in the world, and they draw many kinds of wheeled vehicles. Some of them live and work in places where wheels cannot be used. In such places sledges of various sorts are frequently used.

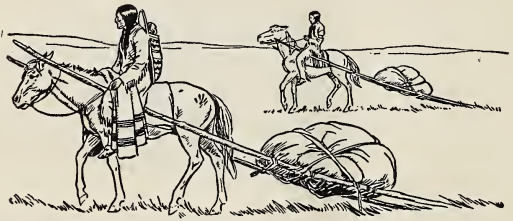
Before we read about these, it will be worth while to look back to the days of the colonists in our own part of the world. Let us see first how the Indians moved their loads, and then how the white men improved on those methods.

The Indians who lived in our own country before the first people came from Europe did not have any carts or wagons. They did not need to make wheels, because there were no roads on which wheels could be used. The only roads ran through thick forests, and were nothing but narrow paths, just wide enough for a horse, or for the Indians to walk in single file.

When the Indians wished to move a village from one spot to another, as they did quite often, they rigged up a simple drag, hitched it to a horse, loaded upon it their wigwams and whatever else they owned, and drove off along the trail.

The drag was called a travail or a travois. To make one, the Indians cut down two small trees, or saplings, and made them into poles about sixteen feet long. They strapped the big end of each pole to

the horse's neck. The tip ends dragged along the ground, six or eight feet back of the horse's heels. Near the ends that dragged, the Indians fastened two or three cross-pieces. Over these they stretched the hide of some animal, and so made a place where food, clothing, blankets, and other things could be carried. Sometimes a seat like a flat basket was fastened across the poles, large enough for one or two Indians to ride on.



Moving-vans of the Indians.

When the drag was loaded, a man or a boy jumped on the horse's back as driver. Others were driven by women with babies strapped on their backs.

When the English Pilgrims and other settlers came to America, they began to make clearings in the forest. They built houses and planted crops in the fields. They widened the narrow trails worn by the Indians through the woods, so that by and by there were roads between the different settlements.

Of course these first roads were too rough for anything that went on wheels. The colonists, however, found a way of making something better than the Indians' travails. When they traveled, they went

on sledges. They used them for their farm work, too.

A sledge was made of a big box set on a pair of wooden runners. It was usually drawn by oxen, because the loads were too heavy for horses to drag over ground full of stumps. Besides, the horses were needed for riding. A sledge was much better than a travail because it was stronger and because it could carry a great deal more. Also, after a man had once made a sledge, it was always ready for use. The Indians had to put a travail together every time they wished to use one, and they took it to pieces again when they came to the end of their journey.

The sledges of the Pilgrims could be used on bare ground during the summer. They ran more easily, of course, over the snow and ice of winter. Vehicles not so very different from them are still used. Improvements have naturally been made, just as there have been improvements in everything else during the past three hundred years, but the general plan of the sledges used in cold countries today is not much changed.

You may know parts of our own country or of Canada or of some foreign land where snow is not cleared from the roads after heavy storms. People there travel in vehicles with runners, for automobiles and vehicles with wheels are not easy to drive at such times. You will think also of the dog sledges of the Far North.

Away up in the Arctic, where there is snow most of the year, the Eskimos could not go hunting without

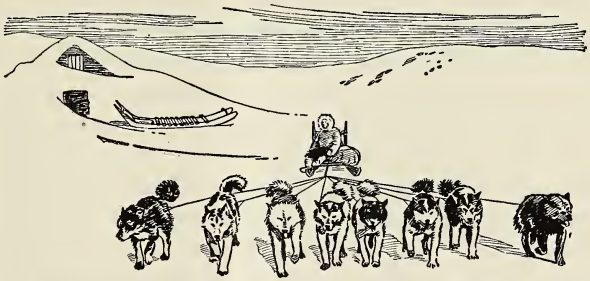
the aid of the faithful dogs. They help explorers, too. Admiral Peary traveled by dog sledge when he discovered the North Pole. Admiral Byrd, although he flew over the South Pole in an airplane, depended on dog sledges for the shorter trips made from his camp in Little America.

Horses work hard for men in almost all parts of the world, but they could not be used where the Eskimos live. One reason is that horses, with their thin coats, could not stand the cold. Another reason is that they would sink so deep into the soft snow that they could not walk. Still another reason is that horses must have hay for food, and this is very rare in the lands of the Eskimos.

The dogs that live in that part of the world have thick coats and do not suffer from the cold. They have very large feet which keep them from sinking in the soft snow. They eat the same kinds of food that people do, and the Eskimo hunters always get plenty of meat and fish.

Eskimo dogs look quite different from any that live in our homes. Perhaps you have seen pictures of them in books or have heard Commander MacMillan lecture about them. They are the same sort of dog that Admiral Byrd took to the Antarctic. Have you seen the movies of them? They have strong, broad shoulders and large heads. Their noses are long and pointed, and their ears are pointed too. They have big bushy tails, which they always carry curled over their backs unless they are tired; then their tails droop. In color most of them are brown, except that the tops of their heads are black

and their faces are striped with white. Now and then a dog is white all over.



An Eskimo dog team. Near the house is another sledge.

There are two ways of hitching dogs to a sledge. In northern Greenland the usual way is to spread eight or more dogs out like a fan and fasten each to the sledge by his own trace which is made of walrus hide. One dog, the leader, has a trace longer than the others, so he can keep a little ahead. There are no reins. The driver guides the team by shouting Eskimo words that the dogs understand, and by snapping his long whiplash either to the left of the left-hand dog, or to the right of the right-hand dog. Snap it to the left, and the whole team swings to the right. Snap it to the right, and they swing to the left.

In Alaska the other way of harnessing dogs is used. There the dogs run along in single file, or else two by two. Perhaps there are as many as eight dogs in line, one ahead of the other. These teams are guided in the same way as the teams in Greenland.

The Eskimos of Greenland make their dog sledges entirely of bone, firmly tied together with strips of walrus hide. They have very little wood, and the few bits of driftwood that they find, they use for fuel. They have no nails, but sometimes they can use on the bottoms of the sledge runners pieces of iron that visiting explorers have given them. When they have no iron, they fasten long strips of whalebone on the runners. In the coldest parts of the Arctic, the runners are sometimes shod with ice. The men dip the runners in water which quickly freezes solid. This helps the sledges to slide more easily, and keeps the runners from freezing to the snow when the dog team stops to rest.

In Alaska there are great quantities of driftwood which can be used in building sledges. The people there have plenty of nails and iron too.

Dog sledges are long and narrow, and usually have a railing along the edge to keep things from falling off. At the back they have a high frame for the driver to lean against, and against which also the load can be piled. This frame has handles, and the men often help the dogs over a rough place by pushing. Sometimes sledges have a mast and a sail which can be used to help the dogs when the wind is right.

A good dog team can drag a load that is not too heavy forty or fifty miles in a day. Of course, when the going is hard on account of the wet snow, the day's journey must be shorter. It is said that if an Eskimo dog has been over a route once, he can be trusted to find it again. Sometimes a man who

has lost his way is guided home by his faithful dogs.

Only a few years ago, some of the sledge dogs or Huskies of Alaska proved how helpful they are to the people of that distant part of the world. Near the Arctic Circle there is a little town, Nome, where about seven hundred people live. Several cases of diphtheria broke out among the children.

The doctor soon used all the antitoxin he had on hand and still the disease spread. He telegraphed to a place in Philadelphia where this remedy is made, and the people there at once sent a supply by a special express train to the railroad station nearest Nome.

There were still six hundred and sixty miles to be traveled, and dog teams were the only means of transportation. The precious antitoxin was placed on a sledge and a picked team of Huskies started for Nome.

Then came a desperate race against time, for new cases of diphtheria were being found every day. At six points along the way, fresh teams of dogs were waiting, and as each of these was reached, the antitoxin was handed over to a new driver. With his fresh dogs he took up the running without a moment's delay.

Across frozen rivers and in the face of fearful blizzards the Huskies sped. Sometimes it was twenty-eight degrees below zero. Sometimes the wind blew eighty miles an hour. Everyone knew that dogs had never traveled so fast before, for records had been kept to show the speed other such dogs had

made in races. At last, 127½ hours after the first team had started, the last relay dashed into Nome. The antitoxin was safely delivered to the doctor and he was able to check the disease. If there had been no swift dogs to transport the needed remedy, diphtheria would probably have swept through the whole town of Nome.

In all, twenty different dogs were used. The three that led the teams over the last relays are the most famous because their work was the hardest. They were named Balto, Scotty, and Togo. Perhaps you have seen the monument in their honor in New York. It stands in Central Park at the corner of the East Drive and Sixty-Seventh Street. The base of the monument is a big boulder, with a tablet that tells how these dogs saved the lives of many children. Standing on the boulder is a likeness of Balto in bronze. The dog himself, with his master, came to the dedication of this monument.

Our stories about Santa Claus mention his team of reindeer, and we have all seen pictures of these interesting animals. Do you know how useful reindeer are to the people who live in the most northern countries of Europe? In Lapland and in parts of Russia, men, women, and children could hardly live without them, for the reindeer supply them with food and clothing, as well as with the means of traveling.

The word reindeer means the deer that pastures himself. It is a good name for this animal because that is exactly what he does. He finds his own food and his own place to rest. His hoofs are split like

those of the ox, and with them the reindeer scrapes away the icy crust and snow, and digs down to the moss that grows along the ground. Sometimes a reindeer has to dig so deep that all that can be seen is his tail, wagging above the bank of snow in which the little animal has almost buried himself. Moss is the reindeer's favorite food in winter. In summer he eats grass and the tender shoots of young trees.

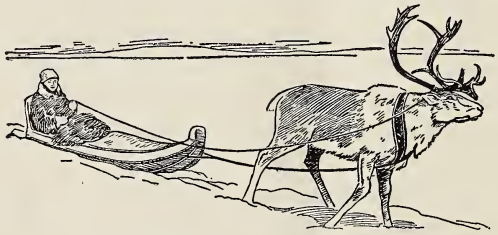
Shelter is something that the reindeer does not need, even in the coldest winter. His head and shoulders are covered with an extra coat of heavy white hair. The rest of his body is kept warm by thick brown hair. The colder the weather, the better he likes it. In the parts of the world where reindeer live, horses and cattle could not live at all. They could never stand the climate, and there would not be enough food for them.

The reindeer is not much bigger than a small pony. He has branching horns or antlers, with which he pushes aside the branches of trees that get in his way. His back is not very strong, so he is not often used to carry people or things. But he is the best possible animal to drag a sledge through the snowy country of Lapland. He does not sink into deep snow as a horse would because he has broad flat feet which spread out as he steps along, much as a camel's feet do.

Perhaps you will wonder why the people of Lapland do not use dogs as the Eskimos do. You can tell why when you think about the food these two animals eat. Which is easier to feed?

The Laplanders have some dogs, of course, but

they are used mostly to help take care of the reindeer. They keep the reindeer from wandering away, and they chase off any prowling wolves. Either a man or a dog must always stay with a herd of reindeer while these animals are grazing. If a single reindeer is frightened and begins to run, the whole herd will follow. They may go many miles from home so that it takes men and dogs several days to find them. Even then some may never be found. In Lapland his reindeer are the most valuable thing that a man owns. He never loses one if he can help it.



A ride in a reindeer sledge.

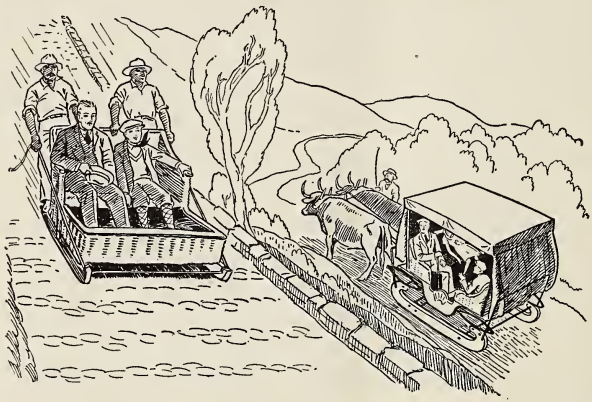
Perhaps you have read that in Lapland the families move their homes from one place to another at least twice a year. Do you know why? At certain seasons, swarms of gadflies attack the reindeer and make life miserable for them. To escape, the reindeer kick up their heels and trot away out of the lowlands. It would be odd if all the cows in America moved away from home in the summer time for a change of air, and if all the farmers packed up and followed them. But this is what the Laplanders' cattle do, and the Laplanders and their families have to go with them.

Would you like to take a ride in a Laplander's sledge? You may have to go alone, for most of these sledges carry only one passenger. Your sledge is long, low, and narrow, and looks a little like a boat. Along the bottom it has one broad runner a foot or more wide. At the front it is pointed, and its sides are curved. At the back is a rest for you to lean against. You sit on the floor, stretch your legs out straight, and tuck the fur robe around you. Then you look about to see how you are to drive. Here is a strip of deerskin tied to the front of the sledge, but you find that it runs between the reindeer's legs and is fastened to his collar; so you cannot use this for reins. Now someone passes you another strip of deerskin, and ties the other end to the reindeer's antlers. Off you go! Don't forget what our Lapp friends have told you about driving. If you wish to go faster, throw your single rein over the right side of the reindeer. And when you wish to stop, throw it over his left side. You steer your sledge by pushing into the snow with a strong stick, much as you steer yourself when coasting on skis.

You may think it odd, but in parts of the world where it is always like summer, the people sometimes use sledges. The hilly island of Madeira, out in the Atlantic Ocean near the coast of Portugal, is one of these places. There are other vehicles on the island, to be sure, but the carroes, as the people call their sledges, are the ones most interesting to know about.

They are light carts made of basketwork, fastened on a wooden platform. Their runners are greased, so they will slide smoothly over the paved streets.

There are two kinds of carroes. One, which is drawn by oxen, has springs, curtains, and an awning. It looks something like an old-fashioned four-poster bed with a canopy. The seats face each other, so some of the passengers must ride backwards. A boy runs ahead, and a man walks alongside, shouting warnings as the carro comes to sharp corners.



The two kinds of sledge used in Madeira.

The other kind of carro is smaller and has no top. It slides down the hills by its own weight. Men run along on both sides, grasping ropes to keep the sledge from sliding too fast and to guide it along the winding path. The passengers all face the front.

A ride in a carro is great fun and very exciting. The longest slide on Madeira is four miles, and it takes about five minutes to go down. You may think that it would be easy for an accident to happen, but the ride is perfectly safe. If we ever ride in a

carro we shall never forget the experience, and we shall surely wish to go again. It will remind us of a slide on a toboggan.

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How They Carried the Goods. C. G. Muller.

Chapter XII. Starving in the Arctic Lands.

"On Winter Trails with the Arctic Nomads." C. S. Strong. *Travel Magazine*, vol. LIII, no. 5, Sept. 1929.

How the reindeer herds move from one grazing place to another, and how the snow caravan travels.

MOVING LOADS WITHOUT ANIMALS

Walking and carrying — Helps in carrying burdens — Riding on a man's back — Sedan chairs — Palanquins — Strange vehicles with wheels — A Jinrikisha ride in Japan.

BEASTS of burden are nowadays so common nearly everywhere in the world that perhaps we do not realize that once there was a time, ages ago, when there were no tame animals. Men had not taught horses, or donkeys, or oxen to carry burdens or to draw loads. When anyone wished to go anywhere, he had to walk. When he wished to move anything, he had to carry or drag it himself or get some other man to help him.

Even today in some parts of the world, these same ways of transportation are used. Sometimes it is because the people are too poor to own beasts of burden. It is cheaper to do the work themselves than it is to get food for animals. Sometimes the country is so rough and wild that there are no roads. The trails are so steep and narrow that animals cannot travel them. In forests and jungles like those in South America and Africa, there are great swarms of insects whose sting is poisonous to animals, so that they cannot work there.

When people have to do the work of beasts of burden, they do all they can to make their loads easy to carry. Sometimes they make pads or baskets of a shape to fit their backs or shoulders. Sometimes they make pads to fit their heads and place their bundles on them.

Travelers in Europe are always surprised to see

how easily the railroad porters carry loads heavier than an American redcap would try to handle. It seems to be the usual thing at European stations for a porter to carry five heavy suitcases at one time. Two hang on straps over his shoulders, one in front and one behind. The man takes another in each hand and tucks the fifth one under his arm. He seems to think nothing of the load.

1 2 3

Burden carriers of far-away lands.

1. Among the Andes in South America. 2. How tea is carried in China. 3. A Turkish hamal.

It is even more surprising to see what loads the hamals or porters in the cities of Turkey can carry. These men walk through the streets of the city bent almost double under the weight of a crate of chickens, a pile of six or eight chairs, or even an upright piano. To help them in carrying these huge weights they use merely simple pads of cloth. Sometimes a strip of cloth is tied around the hamal's forehead and attached to the load balanced on his bent back.

In many parts of the world, if two bundles of about

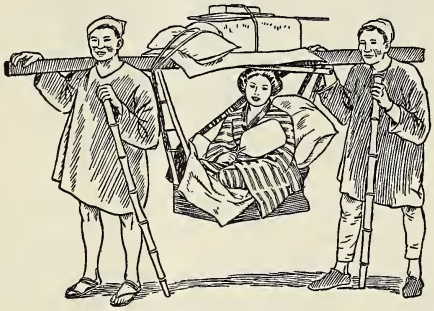
the same weight are to be transported, a yoke is used. This is not at all the same as the yoke used with a team of oxen. It is a wide piece of wood shaped to fit over a person's two shoulders. Part of it is cut out in the middle to make a place for the neck. In Holland we often see women wearing such a yoke, with big bags of cheeses hanging from the ends. In China, instead of using a yoke, a carrier often puts a long pole across one shoulder and hangs a basket of fruit or vegetables on each end so that they balance.

How a Japanese basket merchant carries his goods.

On some of the islands far out in the Pacific, a traveler sometimes rides in a wicker chair, with a footrest, fastened on the back of a man. A parasol is attached, to shield the passenger from the sun. The same sort of vehicle is used also in some parts of the Andes Mountains in South America.

It is hard for a man to carry a man, but if the load is divided between two men, the burden on each is lighter. In some parts of Africa, and also in China and Japan, travelers often ride in a sort of hammock

slung under a long, heavy pole. When everything is ready for the journey, one man lifts one end of the pole, puts it on his shoulder and marches off ahead, while another man carries the rear end in the same way. The passenger sits with his knees doubled up under his chin. Over his head there may be a roof of bamboo or reeds, on which the luggage is balanced. The two men keep up a steady trot, and the passenger swings from side to side, jolting up and down with every step. It is not a comfortable way to travel, but the only other way in these places is to walk.

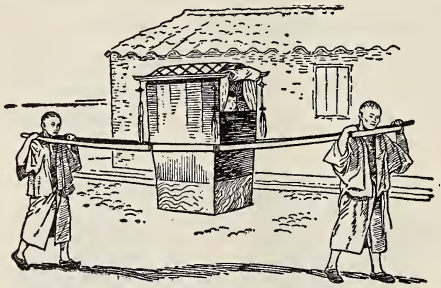


A Japanese lady's traveling chair.

Sedan chairs are a somewhat better conveyance, carried in the same way. They are used in those parts of the Far East where the roads are too rough or too narrow for carts drawn by animals. They are used also in carrying passengers across rivers which are shallow but have no bridges.

Sedan chairs are carried on two long bamboo poles. Built on these is a platform of boards, on which is a

chair with a sort of roof over it. "It looks like a chair inside a playhouse," as a little girl once said. The house is open in front and has side walls of cloth, sometimes cotton and sometimes silk. There are tiny windows at the sides with shutters made of straw matting.

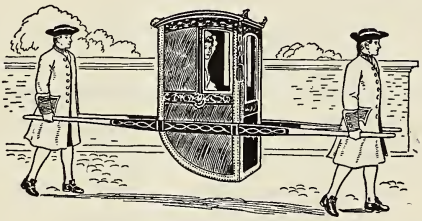


A Chinese sedan chair of today.

When the passenger is ready for his ride, the vehicle is set upon the ground. The passenger backs in, seats himself on the cushion, and stretches his legs out straight. The two men who are to carry the sedan chair kneel between the poles, place the ends on their shoulders, rise to their feet, and start off on a trot. High above the heads of the coolies the passenger sways along, clinging to his chair.

There was a time when people did not have to go to China to see sedan chairs in use. About two or three hundred years ago many were owned by the rich people of London, Paris, and other cities of Europe. There were a few in the English colonies in America.

These sedan chairs were not much like those now used in China, although, like them, they were carried by two men. The poles ran through rings on the sides and could be taken out when the chair was not being used. Sometimes the bearers rested the poles on their shoulders, but usually they held them in their hands. These chairs were first made in the town of Sedan, France. This explains the name. If you have a chance to visit the Gardner Museum, in Boston, you can see one of them.



A sedan chair of olden times.

These sedan chairs of the olden days were beautifully decorated on the outside with pictures by famous artists. Sometimes they were gilded. Inside they were upholstered with silk or satin, and had soft cushioned seats. Each carried only one passenger. At the front was a door with a window in the upper part. There were windows at the sides, too. The top of the chair was hinged so that it could be folded back. Otherwise a passenger would hardly have been able to get in or out, since the roof was very low.

We can imagine how gay the streets of the cities must have been many years ago, when crowded with

the sedan chairs of ladies and gentlemen on their way to parties or to the theater.

Now let us go back to China for a moment. There is another interesting vehicle used there that we should know about. This is more or less like a Chinese sedan chair, although it is considered a much grander vehicle to travel in. It is the palanquin, and its name comes from a word which means bed in one of the old languages of India, the country where that sort of conveyance was first used. A palanquin is really a traveling bed.

The first thing that we notice about one is that it looks safer than a sedan chair. It is closer to the ground. Instead of being perched above the heads of the carriers, the passenger in a palanquin is carried below the height of their shoulders.

The best palanquins are covered with heavy silk and have long tassels dangling from the corners. Sometimes they have silver bells that tinkle merrily as the bearers jog along. The palanquin that a Chinese bride rides in when she is carried to her new home is painted bright red and has ornaments made from the feathers of a kingfisher. A bride is allowed to travel only once in such a beautiful palanquin. After that she must use a sedan chair.

Years ago palanquins were quite common not only in China, but in India, Japan, and other countries of the Far East. Like the sedan chair, they were useful where the ground was too rough or too hilly for wheels. Now that there are better roads in those countries, they are becoming scarce.

So far in this chapter we have been reading about

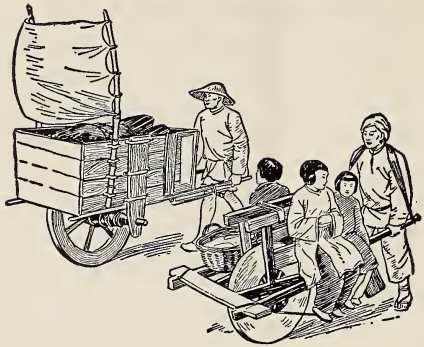
the ways in which men act as the bearers of burdens. On the vehicles that have been described, there are no wheels. Now we come to two that run on wheels, but which have no animals harnessed to them. Men furnish the motive power, but they push or haul their load, instead of carrying it.

In most parts of China there are not many good roads outside of the cities and towns. There are just footpaths about five feet wide, so only men, or animals in single file, can travel on them. They are too narrow for carts. They are usually unpaved and badly out of repair. Some paths, in hilly parts of the country, are like long flights of very low and wide stone steps. Sometimes in the middle of one of these narrow paths we see a central part paved with bricks or stone. Can you guess what this is for?

You probably will not be likely to think that wheelbarrow is the right word for the answer. But wheelbarrows really are, in China, a common way of carrying all kinds of freight, farm products, and people, too.

Chinese wheelbarrows are entirely different from ours. They are much larger, and their wheel is at the center instead of at the front. The floor is a big square platform of boards with an oblong opening, through which the top of the wheel projects. There is a high frame to keep people and things from touching the wheel as it turns. Wheelbarrows often have hoods made of matting to keep off the sun or rain.

When a number of men, women, and children ride in a wheelbarrow, they sit sidewise and rest their feet on cords strung below the edges of the floor.



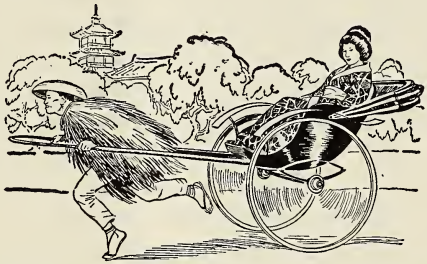
Chinese wheelbarrows.

Sometimes we see a woman riding on one side, while on the other side to balance her is tied a live pig or two or a bag of vegetables. About five hundred pounds is a heavy load for a wheelbarrow. One man can push this weight quite easily, because most of it rests on the wheel instead of on his hands. If a man needs help, either he raises a sail on his wheelbarrow or gets another man to help him. The second man goes in front and tugs on a rope tied to the wheelbarrow. The man who does the pushing usually has a leather strap running from the handles up over his shoulders. You can generally hear a wheelbarrow coming quite a distance away, for the wheel is almost never greased and creaks every time it turns.

In Chinese and Japanese cities there is another vehicle just as strange to our eyes as the wheelbarrow. This is the jinrikisha, a little two-wheeled carriage drawn by a man. It is said that it was invented by

an American missionary who wished to have a way of taking his wife out to ride. Nowadays it is used much as Americans use a taxicab.

Years ago the city streets were full of jinrikishas, and people rode in them when making short journeys between near-by towns. Now, however, there are so many automobiles in the big places that the jinrikishas are being crowded out, for the same reasons that bicycles are now fewer than they used to be in American cities.



A jinrikisha of Japan. The word means "man power carriage."

Usually a jinrikisha is large enough to hold only one person, but there are some that will carry two. In front there are shafts, joined at their ends by a cross-piece. When we are ready for our ride, the jinrikisha man, who is known as a hiki, rests the shafts on the ground, and we step up into the vehicle and seat ourselves. Then the hiki lifts the shafts, throws across his shoulders a strap fastened to them, grasps the cross-piece, and trots off.

He goes about twice as fast as a man usually walks, and can pull a jinrikisha thirty or forty miles a day.

On long trips one hiki draws the jinrikisha a certain distance and then another man takes his place. Sometimes there are two hikis, one between the shafts, pulling, and the other behind, pushing. Now and then both men get between the shafts, although that makes it rather crowded. When we get to the end of our ride, our hiki is likely to drop the shafts without any warning. He stops so suddenly that if we are not careful we shall be spilled out.

The clothes that a hiki wears are interesting. In pleasant weather he has a long blue cotton coat that looks more like a shirt than anything else. On the back of it is his name and number, because the hiki has to be licensed just like a taxi driver. On stormy days the hiki wears a cloak made of long stalks of straw, so that he looks much like a small haystack running about. His hat is a flat one made of straw and wide enough to cover both shoulders.

If you have ever wondered what becomes of old automobile tires, you can answer the question if you look at a hiki's feet. Many of these men wear shoes cut out of old tires, sent to Japan from the United States. Other hikis wear straw sandals which we imagine wear out more quickly than the rubber ones do.

Now let us take a look at our jinrikisha, which is one of the best and quite new. It is nicely painted and has on its sides pictures of dragons and chrysanthemums. The chrysanthemum is the national flower of Japan. There is a folding hood which can be raised over our heads when it rains or when the sun is too bright. There are springs and mud guards,

and, much to our surprise, pneumatic tires. The wheels themselves are bright red and have wire spokes. After dark, the hiki hangs paper lanterns of different colors on the shafts, as headlights.

Jinrikishas are found also in some of the cities of South Africa. There the black men who draw them decorate themselves in all sorts of queer ways. They put strings of beads and ribbons around their necks and wear short coats of many different colors. They make headdresses of gay feathers, and perhaps have sticking out sideways over their ears a pair of curving buffalo horns. Their feet are bare, but below the knees their legs are whitewashed and perhaps painted with wavy colored lines. No one can blame a passenger who stares long and hard at a jinrikisha man dressed in this surprising way.

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How We Travel. J. F. Chamberlain.
Chapter VI. A Journey in a Jinrikisha.

How Other People Travel. E. A. Headley.
Chapter IX. A Trip in a Jinrikisha.

How the World Travels. A. A. Methley.
Chapters IV. Journeys through India; V. The Conveyances of China and Japan.

Transportation. W. F. Rocheleau.
Chapter I. Primitive Methods of Travel and Transportation.

The Ways We Travel. Frances Carpenter.
Chapter II. Odd Ways of Travel in Far-away Lands.

ANIMAL HELPERS

Animals are taught to work — Our friend the horse — Horse litters in China — Ponies and where they are used — Mules and their work — Donkeys in many lands — Oxen are patient workers.

NO ONE knows when four-footed animals were first put to work pulling or carrying loads. It was many ages ago. Probably before men invented wheels, and when they had only sledges on which to draw things, they had tame horses or oxen or dogs that they could teach to work.

There is no way of telling which of the animals first became man's friends and helpers. Some people say it was the dog. We have pictures of dogs made before the days of the ancient Egyptians. Others think it was the horse or the ox. There are stories in the Bible that show that these animals were thought very valuable in those days. History books tell us that in certain countries camels and elephants have been used for thousands of years.

Today as we travel about the world, we see all these animals and many others hard at work. In some lands their places are being taken by modern machines. In others, where there are few roads for automobiles and few landing fields for airplanes, beasts of burden are used as much as ever.

The kind of animal used depends mostly on the climate of a country and whether the land is flat or hilly or wet or dry. Some animals can work only where it is hot and others only where it is cold. Some thrive among mountains and others in deserts and jungles. This chapter tells about several different kinds and why they are suited to their own part of

the world. It tells first about the horse, because he is the most faithful animal friend of us Americans, and because the world over, he is the most widely used of all beasts of burden.

Have you ever, early in the morning perhaps when it was just getting light, heard the milkman's wagon coming along the street? If you live in a city, this is a well-known sound. Perhaps your milkman has a clever horse who knows the route just as well as the driver does. The milkman doesn't have to call "Whoa" when he reaches your house. The horse stops, and the man jumps from the wagon to leave the bottles on your doorstep. Then he whistles or calls softly to his horse, and you hear the wagon start and go along to the next house where milk is to be left. The driver takes a short cut back to the wagon, gets more milk, whistles again, and the horse moves on. This saves time, and the horse seems to know that he is helping the driver. Perhaps the iceman's horses have the same clever trick.

Gradually, we suppose, motor trucks will take the place of horses in delivering milk and ice. They are already doing this in the larger places. We shall miss the wise old animals.

Horses are as faithful servants as we could wish to have. They not only learn quickly and well just what they are to do, but they help in unexpected ways. On a dark night, when a man cannot see the way, a horse will keep in the road, and if a driver loses his way, his horse can take him back home. The horse has a keen sense of hearing, a strong sense of smell, and unusual eyesight. His mouth is tender,

and it is easy to guide him with reins, bridle, and bit. He is strong enough to carry about three hundred pounds on his back and to draw a ton on a good road.

Horses are used in every part of the world except where it is too hot or too cold. Russia has twice as many as any other country. In the United States, which ranks second in the number of horses, most of them are used on farms. Probably the most famous horses in the world are those of Arabia. Horses from that country have been imported into all others, and they have been used in improving all other breeds.

The first horses tamed by man were harnessed to drags, which were probably nothing but flat platforms of boards or logs. After wheels were invented, horses drew carts and chariots, and they have been used to draw wheeled vehicles ever since. Nowadays, of course, there are not very many horses in American cities because the automobiles have taken their places.

The Spaniards, when they conquered Mexico and South America, brought the first horses that the natives had ever seen. When the Indians saw men on horseback, they thought that the two were all one animal.

In the early days of our country, horses were much used for riding. It was many years before roads between towns were wide enough for carriages. A man and his wife often rode together on one horse. The man sat on an ordinary saddle, and behind him his wife rode on a pillion, which was a cushion strapped to the horse. It had a sort of trapeze hang-

ing down on one side, on which the lady braced her feet. To keep from being jolted off, she clung to her husband's coat. Often one or two children of the family rode on a pillion in this way.

How a colonist took his wife to ride.

China is a country that has very slowly learned about modern inventions. For thousands of years the people there were sure that their own ways of doing things were exactly right. They did not like to have people from foreign lands come into China for fear that they would want to make changes. They did not want to learn how foreigners did things at home. As time passed, however, more and more people from the United States, from England, and from other countries were allowed to go into business in some of the Chinese cities. Chinese boys and girls, too, traveled and studied abroad, and returned home with new ideas. In this way, knowledge of modern inventions was taken into many parts of China.

Today in some Chinese cities we might imagine that we were in America. There are broad streets, wide squares, handsome buildings, automobiles, trolley cars, and bicycles. But if we went into other parts of these same cities, we should see sights like those of hundreds of years ago. Through the narrow, crooked streets, crowded with little one-storied buildings would come pack trains of mules, ponies drawing carts, hikis with their jinrikishas, and even caravans of camels.

When we go from one Chinese city to another, we can sometimes take a train or ride in an automobile. It depends on the part of China where we are traveling. If we wished to go where there are no good roads, we might be carried in a horse litter. This is much like the palanquin, which has been described in another chapter. Instead of being carried by men, however, it is carried by horses — one ahead and one behind. The litter itself is covered with an awning made of straw matting. The passenger sits on the floor cross-legged, with thick quilts for a cushion.

Ponies are a special kind of small horse. The ones that we see are usually the playfellows of children whom they draw about the parks and beaches in tiny two-wheeled carts. In other parts of the world ponies have to do work that is really hard. They are strong little animals with shaggy coats. Among some of the high mountains of Asia they are used as pack animals. You would hardly suppose that they could carry the loads that are given them, but they plow bravely through the deep snow that buries the

trails in winter and early spring. They do not easily get tired, and they are very sure-footed on the icy ground.

In the cold parts of Manchuria, which is north of China, the pony is a most useful little animal. It is not necessary to give him any special food or any shelter. He feeds himself by scraping away the snow and nibbling what is left of the grass that grew during the summer. He keeps himself warm by growing an extra coat of thick, heavy hair.

The people there have their own way of harnessing their ponies. We see two ponies hitched to a cart, one ahead of the other. There is only a single rein attached to the front pony, and as you can imagine it is quite a trick to learn how to guide a team arranged in this way.

Good roads and bridges are scarce in most parts of Manchuria, so automobiles and trucks cannot be used. More often than any other vehicle we see two-wheeled carts. It takes six or more ponies to draw the heaviest of these carts, especially when the roads are muddy.

If we were to visit a cotton plantation in the southern part of our own country, we should see heavily loaded wagons drawn by animals which at first we might call horses. When we hear one of them bray, however, we should not be so sure that it was a horse after all. We would look again, and we would see that it had longer ears than a horse, a shorter mane, and smaller feet. Would you know the name of this animal, and why it was used instead of a horse? Perhaps you would say, "It is a donkey," but that is

not quite right. His father was a donkey and his mother was a horse. He himself is a mule.

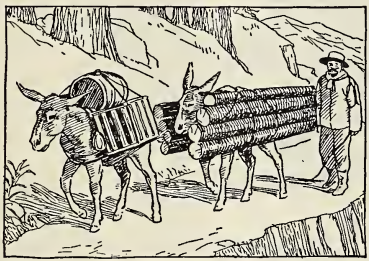
Mules are used in the South because they stand the hot climate better than horses do. They can eat cheaper food and they do not need so much care. They are less likely to overwork than horses are, they are almost never sick, and they live to a good old age. They work just as well when pulling loads as horses do, and as pack animals they are better.

You may ask why the farmers in the South do not use tractors or trucks instead of mules. One reason is that in some places the roads are still rather bad. Wagons drawn by mules travel over roads of this kind more easily than automobiles do, especially when the mud is deep. Another reason is that a farmer can raise his own mules and their food, but he cannot raise trucks and gasoline. Motor trucks are expensive to buy and they are likely to be used only a few months in the year to carry cotton to market. The rest of the time the trucks may be idle. Mules can be used right through the year in plowing, in planting, and in doing many other kinds of farm work.

The mule is well adapted to work in hot and dry countries, especially among the mountains. He is not so well adapted to wet and cold countries. He easily travels the worst roads or paths and can climb steep, rocky slopes as nimbly as a goat. Strangely enough, the mule, even with a load on his back nearly a third as heavy as himself, goes faster uphill than down.

In the West, a great many mules are used. Pack trains, sometimes with a hundred or more mules,

file through the mountain passes. Teams of from ten to twenty mules are often harnessed to a single great wagon when crossing a desert where there are no roads. In Mexico and in some parts of South America mules carry provisions and goods of all sorts up to the plateaus. The people there have to depend on these pack trains because they live far from the few railroads in these countries.



All over the world, donkeys carry loads that seem much too heavy for them. The picture at the left shows them among the mountains of South America. The one at the right shows a strong little donkey of Africa.

In many parts of the world we shall see donkeys oftener than mules. In the West, and in South America and the West Indies they are called burros, which is a Spanish word for donkey. They are sure-footed little beasts, and they never stumble or grow dizzy on high mountains. They are never nervous or frightened even when traveling along the edge of a precipice. Their feet are small, and they can find a firm foothold where other animals could not go at all. They eat very little food and what they need they can find in places where most animals would starve.

Balanced across his back the donkey can carry in two packs as much as a horse can. He will travel long distances without rest. A pack train of donkeys trudges along in single file, each patient little animal following the one ahead of him with almost no guidance from the driver.

A water cart in Mexico. The big barrel is called a hogshead.

In Mexican cities and towns it is a common sight to see a donkey drawing a big hogshead of water for delivery at different houses. All through the West Indies and in South America donkeys are as common as automobiles in our own country. They carry all sorts of loads. When a man rides one, he is likely to cross his legs on the little animal's neck.

In Italy the donkey's load may be a cart full of vegetables. His dinner, a bunch of hay, is likely to be fastened to one shaft where he can nibble at it by turning his head. The driver sits on the other shaft under the shade of a round top which opens like an umbrella and covers the whole cart. Some Italian donkeys are no taller than a good-sized sheep.

In China we often see a donkey carrying two baskets, one on each side, with a rider on his back. There may be a load of vegetables in one basket and a child in the other.

The donkeys in Sicily, whose carts are told about on page 294, are probably the most gaily dressed of any in the world. But there are some in Africa, just across the border from Egypt, that wear a lot of decorations too. They have little red leather saddles, and around their necks, to guard against magic or "the evil eye," their masters hang strings of blue beads.

If your great-grandfather was once a boy on a farm, he probably remembers how the plowing and other heavy work was done with a pair of oxen. They are strong, clumsy-looking animals. Perhaps he can tell you stories that he heard when he was a boy about the long journeys to the western part of our country which people made many years ago in wagons drawn by oxen. These were the "covered wagons" which are described in another chapter in this book.

We are not very likely to see oxen at work in our own country unless we visit an old-fashioned lumber camp in Oregon, in Washington or in the South. There we may find them hauling logs out of the woods or over the road to the sawmill. Most of the farm work that oxen did in the olden days is now done by automobile tractors. We all know that nowadays no American would think of traveling by anything so slow as an ox wagon.

Oxen are always fastened together, two by two,

instead of working singly as horses often do. Several pairs may be hitched to the heaviest loads, one pair ahead of another. The curved wooden frame around their necks is called a yoke. It looks a little like the bows of a huge pair of spectacles. There is a pole or a chain which runs back between the two oxen and connects the yoke with the load. There is no harness, such as a horse has. The man who drives walks on the left-hand side of his team. When he wishes the oxen to move to the right, he calls out "Gee!" When he wishes them to move to the left, he calls out "Haw!" Sometimes he prods them with his stick.

You may ask why oxen, which travel so slowly, are used instead of horses. One reason is that they are much stronger and do not have to strain to draw a heavy load. Another reason is that they are more patient than horses are. They are willing to pull hard for a little distance and then stop for a rest. Horses do not like to do this.

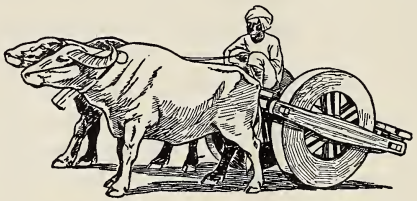
On a road where the mud is very deep or on swampy ground, an ox can travel faster than a horse. This may seem hard to believe when you think how very slowly the ox usually walks. It is true, however, and the reason is this. An ox's hoof is split into two parts while a horse's hoof is solid. When the horse steps on a soft spot he sinks in, and it is hard for him to pull his foot out because of the suction. The foot of the ox also sinks in, of course, but there is less suction to hold it because of the split hoof. A pair of oxen can drag out of a miry road an automobile that could not possibly be driven out under its own

power. This shows you how firm-footed the ox is even in deep mud.

Many more oxen are used in other countries than in the United States. We often see them in Mexico and in Central America, pulling great clumsy carts with wheels of solid wood, much like the first ones ever made. In those countries there are not many railroads, and the roads are few and poor except near some of the cities. The ox carts take the place of freight trains and motor trucks. Across the plains of Argentina teams of eight or ten oxen draw huge wagons whose wheels are eight feet tall. Even when the mud is nearly four feet deep, as it is sometimes, these big wheels help the wagons roll through it. If there were no oxen, however, it would be more of a struggle than it is. Among the Andes Mountains, oxen are used as pack animals during the rainy season, because they are less likely than mules to get stuck in the mud.

When we travel in Italy, we often meet huge oxen with wide-spreading horns. Usually they are creamy white and very handsome. They seem to be well cared for. Many have garlands and flowers on their foreheads. Some of them work on farms. Others draw sledges carrying great slabs of marble from the quarries among the mountains. Then there are eight or more oxen in the team. The driver sits on one of the yokes, facing backward, so that he may see that no accident happens to the load. On a country road we may perhaps meet a queer team in which an ox, a horse, and a donkey all help haul the master's load. We wonder how the animals enjoy working together.

The farmers of Spain and Portugal who own oxen seem to be very proud of them, and to take good care of them. Their yokes are often prettily carved, and the oxen themselves may have head coverings of shaggy goatskins to protect them from insect pests.



Carts like this have been used in India for ages.

Oxen of a special kind are well suited to work in India because they can stand the heat and the moist climate, and because they are not poisoned by the insects that are so common there. Most of the freight in India is hauled by ox teams. Oxen often draw small carriages too. There are also wagons big enough for a whole family. It is surprising to see how many people can crowd themselves into one wagon. These vehicles are gaily painted, and have solid wooden wheels, wooden springs, and a thatched roof or else a canopy made of matting. Like the people in other parts of the world where it is very hot, the men, women, and children of India are not disturbed if a journey takes a long time. In their shaded ox carts they are probably as happy going a mile and a half in an hour as we are in automobiles going more than twenty times as fast.

The oxen used in transportation in Japan often

draw very heavy loads, but in spite of that are much dressed up. Now and then we meet an ox wearing a cover of white cloth on his back and sandals of straw on his feet. The sandals keep him from slipping on wet pavements and also prevent his feet from becoming sore on long trips.

He may be drawing a cart loaded with great pieces of lumber thirty feet long. He may be plodding into a city with a cargo of vegetables or fruit. When he goes home to his farm at night, he may carry back a load of sewing machines or phonographs for his master's neighbors.

We should expect oxen to be a little shy of electric cars, automobiles, and taxis that crowd the streets of Japanese cities. Strange to say, this is not the case. Instead, the motormen and the chauffeurs have to slow down or perhaps stop while the ox team gets out of the way. The boys on bicycles, of whom there are many, have to ride so slowly when an ox team gets in front of them that they nearly lose their balance.

The man who drives the ox never rides, but walks the whole way into the city and back again. He guides the animal by a single rope through a ring in its nose. On summer days a row of oxen may usually be seen taking their noon rest under the trees on a wide busy avenue. The oxen's food is carried in a wooden bucket from which they eat. Watering places are scarce, so the drivers bring water from the street pumps to the thirsty beasts. The oxen of Japan seem to be well cared for and healthy, even if they do work hard.

Sometime, no doubt, when automobiles become more common in Japan, these patient beasts will give up drawing burdens. They may still be used for work on the farms or they may be allowed to spend the rest of their days in idleness out in the cool, grassy country.

WHAT TO READ

How the World Rides. F. C. Fox.
Chapter I. Animal Friends and Their Service.

How the World Travels. A. A. Methley.
Chapters VI. Journeys through Africa; VIII. Traveling in the Wilds.

"The Story of the Horse." W. H. Carter. *National Geographic Magazine*, vol. XLIV, no. 5, Nov., 1923.

The Ways We Travel. Frances Carpenter.
Chapter VI. Our Friend, the Horse.

The World We Live In and How It Came to Be. Gertrude Hartman.
Chapter IV. Man the Animal Tamer.

UNUSUAL BEASTS OF BURDEN

The yaks of Tibet — The carabao — Elephants at work — The "ship of the desert" — Camels in other lands — The little cousin of the camel — Dogs that work for a living.

WE HAVE been reading about several kinds of oxen, and how they are used in many parts of the world. Each is quite different from every other kind, but is well suited to the climate in which he lives and to the ground over which he travels. Where there are mountains, the ox is big and has a heavy coat. Where the land is low and hot, the ox is small and has a light coat.

On the map of China, down near India, you will find a part named Tibet. Between China and India you will see the Himalaya Mountains, the highest in the world. Tibet is sometimes spoken of as the roof of the world. Can you tell why?

In Tibet there are no railroads and no automobiles. The climate is too cold for horses. There is only one beast of burden, but he is able to do anything that the natives want him to do. He is the yak, a kind of ox. He is larger than the American ox, and sometimes grows to be six feet tall. His back is humped. His coat is long and shaggy, with hair that often reaches the ground. On his shoulders are tufts of hair, and along his sides are thick fringes. He is well protected against the cold, you see.

The yak's horns are curved. A traveler says, "The yak has a head like a cow, a tail like a horse, and as he plows his way through the deep snow, he grunts like a pig and grinds his teeth." This sounds as if he were a very strange animal, doesn't it?

All through Tibet, there are long, hard climbs, over hills strewn with boulders. But the yak is sure-footed and so strong and patient that he often carries a whole family on his back. Like the oxen of India, he travels only about a mile and a half in an hour. He is guided by a rope tied through his nostrils.

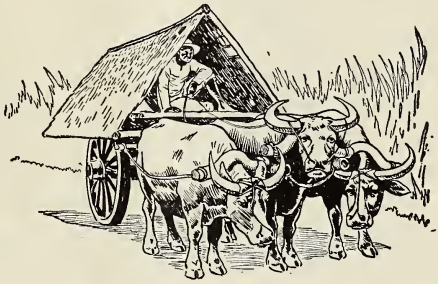
The yak, even heavily loaded, plows through the deepest snow.

Without the yak the natives of Tibet would have no way of traveling. They could bring into the country only what they could carry on their own backs, and they could not plow their fields. Like the reindeer in other cold countries, the yak furnishes meat and milk, and his hair is woven into cloth.

In the Philippine Islands, out in the Pacific Ocean, we find a kind of ox that is not exactly like any other. This is the carabao. He is also called the water buffalo, because he loves to wallow in the muddy water. This is a very good thing for him to do because it frees him from the swarms of insects that

attack him. When he comes out of the water the carabao is coated with mud. This dries on his hair and keeps the insects from biting him.

In some ways the carabao reminds us of the yak, the ox used in Tibet. He moves just about as slowly as the yak does, and he has black hair. But he is much smaller, only about four feet tall, and his coat is short and thin. His horns curve backward, and instead of being round, they have three sharp edges.



Would you enjoy driving a carabao cart?

The carabao can travel through marshy ground where no other animal could go, and so is very useful in working in the rice fields which are nearly always flooded with water. If he should sink below the surface of a bog, he could still get out without help. Most animals would drown. He dislikes white men, but is a willing worker for his native masters. He refuses to work, however, in the hottest part of the day.

Like the yak, the carabao is guided by a rope through the nostrils. Sometimes three carabaos are

fastened abreast to a heavy two-wheeled cart, and draw a load of rice to market. The roof of the cart is shaped like a V upside down, and is made of rattan or bamboo. The natives use this cart for traveling also, and since they are sheltered from the sun they do not seem to care if their animals take a long time on the road.

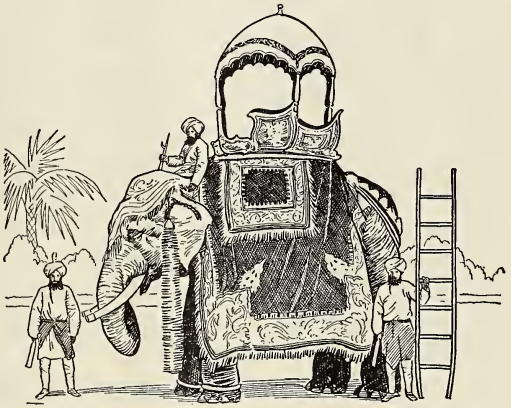
In our own country we usually see elephants only at the Zoo or in a circus. But all over India and in parts of Indo-China and Africa, where the climate is too hot for horses, elephants are used to carry loads or to haul them just as our horses or mules or automobile tractors do. In those parts of Asia where teakwood grows, elephants are taught to pile the heavy logs as carefully as men could pile them. When we watch elephants at this work, we are interested to see that they are never satisfied until their logs are so firmly placed, one upon another, that there is no danger of any of them falling from the pile.

An elephant has a sort of finger at the end of his trunk with which he can pluck a single leaf or even a blade of grass. Perhaps you have seen one pick up peanuts one at a time. Did you know that this little finger is so strong that it can pick up a bale of hay? The elephant uses it to feel along the edges of a pile of teak logs, and if he finds any that stick out beyond the others, he keeps moving one log this way and another log that way until each side of the pile is straight up and down.

When it is time to use the teakwood in the construction of a bridge, the elephant drags it through the jungle to the bank of the river. He does the

work of a motor truck on roads no automobile could travel.

Elephants do other kinds of work, too. Tiger hunters ride them into the jungles, and farmers use them in the fields. An elephant is strong enough to drag a plow, a harrow, and a heavy roller one behind the other. In this way a farmer can plow his land, harrow it, and roll it all at the same time.



An elephant, with the mahouts and a howdah.

Elephants cost a great deal of money, and they eat so much that only rich men and the Government can afford to own them. The native princes of India have many in their stables and use them on special occasions. When an elephant is to be in a procession, he is very beautifully decorated. On his tusks are fastened flowers or enormous jewels. His head is painted in colors as gay as a parrot's feathers. Over his sides are hung velvet blankets embroidered

with gold, reaching nearly to the ground. On his back is strapped a small pavilion called a howdah, in which the riders sit. It has soft cushions and curtains of colored silk. Its sides are carved and gilded. Usually there is a roof or canopy, but some howdahs are more like open baskets than anything else.

Since an elephant may be anywhere from eight to eleven feet tall, we wonder how people ever get into the howdah. When everything is ready the driver of the elephant, who is called a mahout, makes the elephant kneel by tapping him lightly across the knees. The elephant bends his forelegs, and stretches his hindlegs straight back along the ground. A short ladder is placed against the side of the howdah, so that it is very easy for the riders to climb up. The mahout takes his seat on the elephant's neck, and the great animal rises. He straightens his forelegs first, and the people in the howdah lurch backward. Then up come the hindlegs, and the riders are jolted forward.

When the elephant walks, he swings his legs on the same side of his body at the same time, which gives the howdah a queer, swaying motion. Do you know another animal that does this? How does a horse usually move his legs?

To guide the elephant, the mahout strikes or prods him on one side or the other of his head with a long stick. Sometimes there is another mahout who walks ahead of the elephant to help guide him.

It is believed that elephants may live to be a hundred and fifty years old. Their sense of smell is very keen, and so is their hearing, but their eyesight

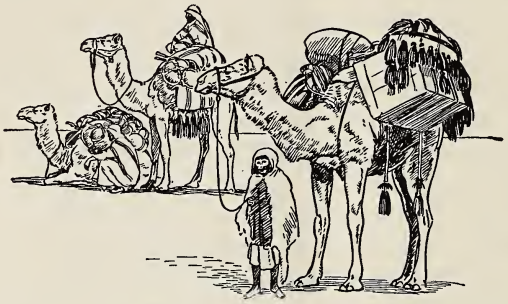
is poor. When they sleep, they either stand up straight or lean against some big tree. An elephant can carry nearly a ton at the rate of four miles an hour. He has great thick pads on his feet and can cross rough places where no automobile can be driven. In those parts of the world where elephants live, they have always been a great help to man, and it is hard to believe that any modern machine can ever wholly take their place.

Someone has said that in any animal show the camel, without trying, would take the first prize for ugliness. Perhaps this is so. But there is an old proverb, "Handsome is as handsome does," and the camel certainly works in parts of the world where no other animal could. So we ought to praise him for this, and not think too much about his homely face, his long, crooked legs, and his humped back. The camel not only works as a beast of burden, but also gives milk for food. Camel's hair is often woven into clothing.

The Sahara Desert is a wide expanse of stony sand in the northern part of Africa. It is almost as big as the whole of Europe. There are no large cities in this desert, but there are many places known as oases. An oasis may be quite a good-sized town or only a cluster of a few houses. Whether large or small, it is the stopping place for camel caravans. These travel north and south between the big cities along the Mediterranean Sea and the towns and villages in the central part of Africa.

A caravan consists of a large number of camels, sometimes as many as a thousand. It is divided into

several groups of camels, and each division is called a train. In a train the head of each camel is tied to the tail of the one next ahead. The first one of all is always ridden by a man who guides him.



Camels loaded for a journey.

Going north, caravans carry packs containing gold dust and precious stones, earthen jars of olive oil, ivory tusks from elephants, ostrich feathers, bales of goat skins, and bags or boxes of dates. On their way back, they carry all sorts of things from Europe, such as tools, firearms, clocks, shoes, cotton goods, indeed whatever the people of the oases need that they cannot obtain from the oases themselves.

The reason why the caravans stop at the oases is that only there can they find water, shade, and food. An oasis always has springs of water and usually palm trees on which dates grow. There are fertile fields where certain vegetables grow. Around the oasis walls of clay have been built to protect the place from the storms of wind and sand that sweep over the desert. A caravan always starts out from

an oasis in the cool of the day, and proceeds on a carefully planned time-table so that it is always known when it will arrive at the next oasis.

Now let us see why camels are so well suited to travel across a desert. The oases are quite long distances apart, so the camel must be able to travel far without food or water. His hump is a provision box, for it is made of fat, and when the camel can find no food, this hump feeds him just as if he were eating. At the start of a journey the hump will be large and firm. At the end it will be very small, or perhaps it will have disappeared entirely. Then the animal must be given a lot of food.

The camel is almost the only animal that loves heat and dryness. He has a thick coat of shaggy hair that keeps the blazing sun from heating his blood too much. He does not mind the fine sand that often sweeps across the desert in thick clouds. His heavy eyelids and thick lashes keep the sand out of his eyes, and his nostrils are narrow slits which he can close when the air is full of sand. His throat has a tough lining, like leather, so that he can eat the thorny plants of the desert if he can find nothing better.

The feet of the camel are broad and flat, so that they do not sink into the deep sand. Instead of a hoof like a horse, the camel's foot has two toes, each with a big nail. They are joined by a sort of cushion. The hot sand does not burn him, and he is sure-footed in stony places.

For water the camel depends on the pouches that line his stomach. He has muscles that open and

close these pouches whenever he needs water. A thirsty camel at the end of a journey will sometimes drink sixteen gallons of water without stopping. This shows you how much water his pouches will hold. It is more than you would drink in six weeks, even if you drank six glasses a day. There is a saying that a camel can smell water a mile away and go straight to it.

A camel likes water to drink, but he doesn't like to get wet. It is said that the camel is the only animal in the world that cannot swim. Of course in the desert there are no streams of water. But, as you will learn later in this chapter, camels are used in some countries where there are rivers. They make a great fuss when they have to wade through one.

When a camel is to be loaded, his driver makes him kneel. He does this by making a clucking noise in his throat and by pulling the camel's beard. The camel kneels by folding his forelegs first, and then his hindlegs. He has thick pads to protect his knees and his breast. The load must not be placed on the camel's hump, for this is his tenderest spot. Therefore a wooden frame is placed around the hump, and the goods are fastened to that. Sometimes a straw mat is laid over the hump to protect it from the sun's heat.

If a camel thinks that his load is too heavy, he will not get up. He grunts and groans until his driver pretends to take something off. Then, whether anything has really been taken off or not, the camel raises himself to his feet, satisfied to go along. To keep a camel from wandering away when the caravan stops,

the driver folds back the lower part of one foreleg and ties it to the upper part. On three legs no camel could go very far or very fast.

A camel can carry from three hundred to five hundred pounds and can keep up a steady pace of five miles an hour. He seems to lurch when he walks, because, like the elephant, he steps forward first with the legs on one side of his body and then with those on the other side. The first time a person rides a camel, he is likely to be a little seasick, for he is constantly tossed first to one side and then to the other. He is also rocked backward and forward. It is not easy to get used to all this motion.

If you were going to ride a camel, would you know how to get up on his back? Your driver first makes the camel kneel, of course. Then you step on his neck, and with a little jump get yourself into the saddle. Perhaps there is a short pole fastened to the saddle in front. If there is, you can curl your knee around it. But most saddles have stirrups. Some riders are skillful enough to stay on a camel simply by crossing their feet and resting them against his neck. When a camel is ridden, he is guided by a bridle attached to a ring in his nose. Sometimes the saddle has a cushion covered with gaily colored cloth, and sometimes there is a canopy or sort of tent over the rider's head.

You will be surprised to know that some people who have studied about it think that ages and ages ago camels lived in North America. In those days, most of this part of the world was a sandy desert. By and by, forests grew and the camels looked for a

new home. Some of them went across to Russia. If you look on the map, you will see a long string of islands stretching out from Alaska toward Asia. It is thought that perhaps there was dry land all the way across. These islands are just the mountain tops that still show above the water, and all the rest of the land has sunk below the waves.

Other camels went down the coast to South America. Probably the little llamas that are found there today are the descendants of those camels. A few pages farther on, you will read of ways in which llamas are somewhat like camels. You will be surprised to know, too, that about seventy-five years ago some camels were brought to the United States and used in the sandy parts of the Southwest. This was before there were any railroads there, and the explorers thought that camels would be the best means of traveling. The plan did not work out well, however.

Today camels are used in Russia, China, India, Egypt, Persia, Turkey, and Australia as well as in Africa. Those used in Russia and China have two humps and thicker coats than the others. The shaggy hair that keeps out the heat in Africa keeps out the cold in northern countries.

In China camel caravans usually carry such things as silk, shawls, and tea. A pack of dogs usually runs on ahead and a little donkey leads each train. The dogs help to guard the train at night, and the donkey helps to find the way, since a camel has to be guided. The donkey may have his left hind hoof gilded. The Chinese think that this brings good luck to the caravan. The leading camel has a rider who carries a

spear with a banner. The last camel has a big square bell on his neck.

In India camels are often harnessed to carriages. Two camels are a sign that a man is quite important, and four camels that he is very important. In Egypt tourists like to ride camels on some of their excursions, but not many other people use them. Persia is a country where most of the roads are merely paths, and camels are very common. Australia has a wide desert which divides the continent into two parts, The easiest way of crossing it is by camel team, when sometimes as many as eight camels are harnessed to a wagon.

There was once a time when no one believed that anything could ever take the place of camels. But now, almost everywhere that camels are used, more modern ways of transportation are being tried too. Automobiles with caterpillar wheels have made journeys across the desert in a few days that would have taken a camel caravan three months to complete. Short railroads have been built between important towns, and plans are being made to lengthen these lines as rapidly as possible. The safest routes for airplanes are being studied, so that sooner or later modern machines will be doing much of the work that camels have done for so many hundreds of years.

In South America, among the high mountains of the Andes, we see interesting little beasts of burden called llamas. They have never been found in any other part of the world, but are very common in Chile, Peru, and Bolivia. Horses and mules are used to carry the loads through the lowlands near the

coast, and donkeys are used on the lower parts of the mountain trails. When these trails get very steep and rough, however, the donkeys turn back and their loads are given to llamas. We often see pack trains made up of hundreds of these small animals, filing along the mountain slopes of the highest Andes. A llama can carry only about half as much as a donkey, and this is why we see so many more of them.

The sure-footed little llamas of the Andes Mountains.

There are several reasons why llamas are well suited to work among these mountains. A llama has a heavy coat of woolly hair which protects him against the cold, while a donkey's hair is quite short. He is even more sure-footed than a donkey, and he has padded feet which do not need to be shod. A donkey has small, tender feet which must be protected against the sharp stones that cover the paths. So the donkey has to wear shoes. A llama can go a long distance without water, and he can browse on the coarse grasses and bushes which no other animal could eat. A donkey needs grain and hay for food, and these are not to be found among the highest Andes. Water

is scarce there too. So, although a llama cannot bear so heavy a load as a donkey can, he is better adapted to this part of the world.

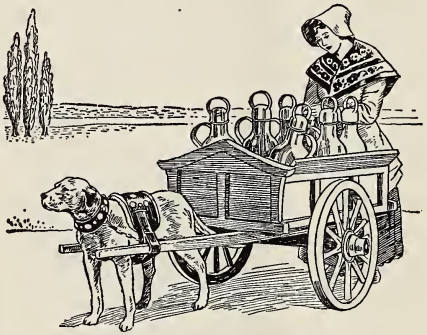
A llama can carry a hundred pounds or so, traveling about as fast as a man walks. At each step he bobs his head forward or back. If you load a llama too heavily, he, like the camel, lies down and refuses to move until you take something off. In this way he is a little smarter than the camel, for he cannot be fooled. As a rule, he is gentle and patient, and travels all day without making any complaint. For this reason he is a pleasanter helper than the camel is.

The llama is sometimes spoken of as the little cousin of the camel. Although he has no hump, he is like his cousin in several ways, some of which we have already told you. He is much smaller, of course, but he is just as useful in his native land as the camel is in Africa. He has been used as a beast of burden longer than any other animal in South America, and we expect that he always will be used. It is hard to believe that there will ever be many railroads in the places where he does his work. Airplanes can fly over the mountains, but there are very few landing places among the highest peaks. So here seems to be one little animal friend of man that is not likely to be crowded out by modern machines.

Llama milk is used by the people for food, and llama hair is woven into blankets and clothing.

You have read in another chapter how dogs help their Eskimo masters. There are other parts of the world, too, where dogs have to work for a living. They are big, smooth-coated fellows, a good deal like

the police dogs that we see so often here at home. In Holland and Belgium, especially, these dogs are kept very busy. In some of the oldest cities of these countries the streets are so narrow that two wagons drawn by horses cannot pass. That is one reason why dogs are used.



A milk cart in Belgium.

They are harnessed to neat little carts, filled either with vegetables or with big bright cans of milk. With their master, who sometimes gets between the shafts himself to help with the pulling, the dogs drag their load from house to house. There are often two dogs to each cart. When there is only one dog, he is sometimes harnessed right under the cart, and follows close at his master's heels, tugging with all his might. While the man bargains with his customers the dogs are likely to take a well-earned rest in the shadow of the cart. At lunch time each is given his own piece of carpet to lie on, and he is pretty sure to have his own bowl for food and water, too.

Sometimes the dog's master is a shopkeeper. The

only shop he has is his cart, which he loads in the morning with whatever articles he sells and drives to a street corner. There the man stands all day in pleasant weather, selling what he can to passers-by. At night the faithful dog pulls the cart home, probably hoping, like his master, that business will be better tomorrow.

In some of the other countries of Europe, especially France, Germany, and Switzerland, dogs are more likely to work on farms than in the towns. In their carts they carry from the fields to the barns vegetables, fruit, or hay. Sometimes they go to the woods with the woodcutters, and come back with their carts piled high with bundles of twigs and small sticks for the kitchen fire.

We hope that all these hard-working dogs are given some time to play. There are boys and girls everywhere who love to romp with their animal friends, and there is no better playfellow than a good dog.

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Sailing the Seas

WE VISIT A BUSY HARBOR

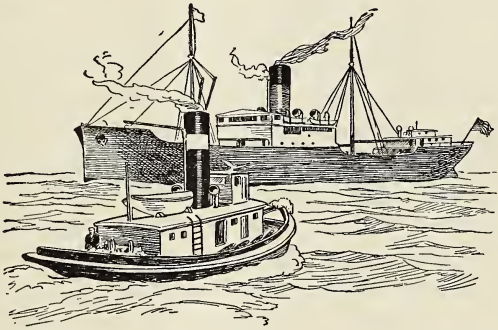
Along the water front — Ships from foreign lands — What do the ships carry, and what will they bring back? — The harbor of New York — Why ships are put into the dry dock — Some important seaports — Harbors of the Great Lakes.

IF WE live in a seaport, a visit to the water front is sure to be one of our favorite excursions. We can always find something interesting to watch. Perhaps a big ocean liner, with two or three smokestacks or funnels, is just sailing for Europe. Her band is playing and crowds of people are waving good-by to their friends. Perhaps a smaller steamship, with only one funnel, is coming in from a long voyage. She is not quite so spick and span as the big liner, and we see a few sailors but no passengers on her deck. This ship is a freighter, and if we wait to see her unloaded, we shall learn a lot of geography without having to read it in a book.

Let us keep our eyes open, and we shall be able to tell a great deal about what people in the country from which the ship comes make in their factories, what they grow in their orchards and on their farms, what kind of fish they catch, and what metals they dig from their mines.

If we visit the harbor of San Francisco, for instance, we may see an American steamer from Hawaii unloading sugar, rice, bananas, pineapples, and honey. A Japanese liner may be landing chests of tea, bales of silk, crates of dishes, and rolls of straw matting.

Perhaps another American steamer loaded with steel rails from Pennsylvania has come to the Pacific Coast by way of the Panama Canal. At certain seasons sailing vessels packed full of salmon caught and packed in Alaska bring their cargoes to California ports.



The tramp steamer is coming into a harbor. The tugboat will help her into the dock.

In New York Harbor we may watch steamships from Europe unloading Christmas toys from Germany, cheese from Holland, sardines from France, herrings from Norway, and soap from England. Another has brought rubber from the East Indies. A third ship has hides from Argentina, coffee and nuts from Brazil, or copper from Chile. Several tankers, with oil from Texas or Mexico, have brought a supply for the refineries in New Jersey. We can always tell an oil tanker from other ships because her funnel is near the stern. What other cargoes have you seen being unloaded from a ship in some harbor that you have visited?

There is much to learn, too, when we watch a ship loaded for a voyage to some foreign land. Our country sends abroad a great deal of the cotton that is raised in the South and of the wheat that grows in the central States. We export, also, machinery of all sorts, automobiles, different kinds of oil, and large quantities of the various products of our packing houses. This is not the whole list, by any means. You have doubtless seen ships being loaded with other American goods. Can you tell what they were? Some of the things go to Europe, some to South America, and some even to Africa, or far-away India, China, and Japan.

When we think of our trade with hundreds of ports in all parts of the world, we understand how every country needs many things that are made or grown in another. Nations have to buy and sell just as people in cities and towns do, and friendship between nations is just as necessary as it is between neighbors.

Nearly half of the foreign commerce of our whole country enters or leaves New York Harbor. There we can see a greater number of ships and more kinds of ships than anywhere else in the world. Let us imagine that we are visiting this busy place. Probably the best way to watch the traffic in the harbor is from Battery Park at the very southernmost tip of the city. So we take the "L" train downtown to see what the harbor has to show us.

Perhaps you do not realize that New York is built on a long narrow island, named Manhattan. Once the region was occupied by a tribe of Indians bearing

this name. In the Indian language it means People of the Whirlpool. Probably the rough waters of the part of the East River which is now called Hell Gate is the Whirlpool the Indians knew.

You can go completely around the island in a sight-seeing boat. That would be an interesting trip to take some day. Manhattan Island has a wide river on each side and these form the harbor. The East River separates New York from Brooklyn, and across the North River is New Jersey. The shores of each are lined with docks where steamers of all sizes load and unload.

Battery Park is located where the two rivers flow together and widen out into New York Bay. Its name comes from the fact that about three hundred years ago the colonists set up on this point a number of cannon, or a battery, so that they could fight off any enemies that came by water. Here is another bit of history. When the British were driven out of New York City in the Revolutionary War, they left their flag flying. It was nailed to a pole near the old battery. They greased the pole so that no American, they thought, could climb it and lower the flag. An American soldier, however, shinned up, tore down the British flag, and raised ours in its place.

There are at least seventy-five different steamship lines using the New York docks, and their ships fly the flags of many different countries. There are American lines, and British, French, German, Italian, Dutch, Spanish, Swedish, Norwegian, Greek, and Japanese. Their steamers go everywhere in the world, some to one port and some to another. The

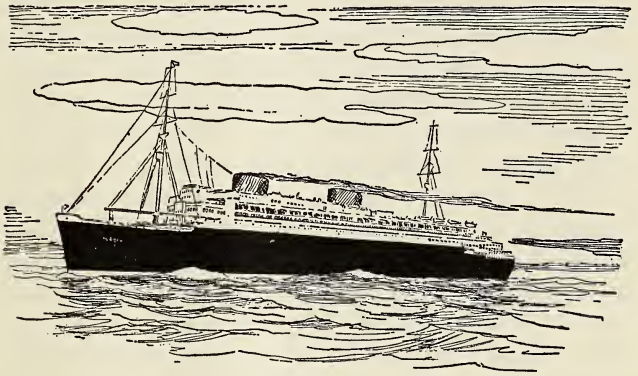
steamers that go up the Hudson River, however, or along the coast of the United States must be American, for the law does not allow foreign vessels to carry passengers or freight from one port in our country to another.

We are told that there are more than seven hundred miles of water front in New York Harbor, counting all the docks. If they could be pieced together in a straight line, they would reach all the way from New York to Chicago or to Savannah. We are told also that in a single year the total number of steamship sailings from these docks is fifty-two thousand. Someone has figured out that if that many different ships could be brought together at one time and sent to sea one by one ten minutes apart, the last ship would be leaving the harbor almost exactly a year after the first one. These figures will help you to realize the extent of New York's water front and the amount of traffic there.

Now we are arriving at Battery Park, and it is time to look around us. What great ship is this, with two big funnels painted red at the bottom, then a narrow strip of white, and blue at the top? She seems the handsomest ship that we have ever seen. Our guide tells us that she is the Washington, one of our newest American ships. She and her sister ship, the Manhattan, are the two largest ocean liners ever built in this country. The Washington steams slowly up the bay and turns into the North River. She is finishing a voyage from Europe and is headed for her dock.

Just as she passes, another huge black steamship

comes down the North River. She has two short, wide funnels painted buff. Presently we make out the German flag. We are told that this is the Bremen, one of the fastest ships in the world. We would like to see her steaming at full speed, but the waters here are too crowded. Once the Bremen gets out on the ocean, her powerful engines will be set to work at full power.



The steamship Bremen. She has a sister ship named Europa.

In June, 1935, the French liner Normandie, the largest ship in the world, set a new record from Havre, France, to New York, a distance of 3191 miles. Her time was 4 days, 11 hours, 42 minutes. She is driven by electricity. The Italians, also, have a very fast ship named Rex which once crossed the Atlantic at an average speed of 30 knots, or about 35 miles an hour. The British have launched a steamship named Queen Mary, about the size of the Normandie, which they hope will be even swifter.

Here comes a pretty ship, all painted white. She is a good deal smaller than the trans-Atlantic liners.

We soon see that her smokestack is black at the top, and buff at the bottom. Between these colors is a band of red, with a big white diamond on it. We hear someone say that she belongs to the United Fruit Company, and that she is bound for her dock on the East River. She is bringing a cargo of bananas from Central America.

The endless procession of ships goes on. There are vessels that look like schooners, for they have two or three masts, but no smokestacks. They may be fishermen, or they may be loaded with coal, ice, or lumber. They have no sails set. Even so, they are going along quite as fast as the steamers. We are told that they have gas engines which they must use instead of sails in New York Harbor. We understand why this is necessary, for a vessel driven by machinery can follow a much straighter course than one which depends on the wind. The harbor can have no roads marked like the streets of a city, but each kind of vessel must follow the route that is set for it by the harbor rules. Every vessel does this very closely, so there is hardly ever a collision.

Everywhere we look, it seems, we see big ferryboats plying back and forth between New York and the cities across the two rivers, or to and from the different islands. They are packed with passengers all day long and into the night. Someone tells us that in a year the total number of passengers carried by these boats is just about equal to the whole population of our country.

We see a good many noisy tugboats puffing along with a tow of barges. Sometimes these are loaded

with sand or bricks, and are on their way to the city. Sometimes they are full of rubbish. New York has an immense quantity of waste each day. Scraps of old iron, broken boxes, tin cans, and all the other things that in other cities would be carted off to the dump are loaded into flatboats. They are towed far down the harbor to some place close to the shore where new land is being made, and there they are thrown overboard. In years to come new parts of the city will probably be built on land made in this way.

There are other barges called lighters, which seems a strange name, since they are really not light at all. They are used to lighten, or unload, ships anchored out in the bay. It is sometimes cheaper to use them than it is to bring a ship up to a dock. Some lighters have derricks built upon them, so that heavy cargoes can be handled more easily.

We see also dredges busily at work making wider or deeper some part of the ship channel. They scoop up from the bottom great bucketfuls of mud. This also is loaded on flatboats and towed away to be dumped where there is no danger of its drifting back into the channel.

Now and then a surprising thing happens. A powerful tugboat passes, towing a long wide float on which are several lines of freight cars. Until we see it with our own eyes we should never suppose it possible that any boat could hold such a load.

We hardly expect to see canal boats in a harbor, but here we see some being towed up the North River. Then we remember that the old Erie Canal,

or New York Barge Canal as it is now called, runs across the State from the Hudson River. Boats can start at Buffalo and come all the way to New York City, part way through the canal and the rest of the way by the river. How the Erie Canal came to be built is a story by itself. You will find it on page 376.

At Battery Park is the station of the fire boat New Yorker. She has powerful pumps and long lines of hose. Whenever there is a fire on the water front, this boat sounds her siren, dashes out of her dock, and speeds away in answer to the alarm. It is an exciting thing to see, especially if the alarm calls out more than one fire boat.

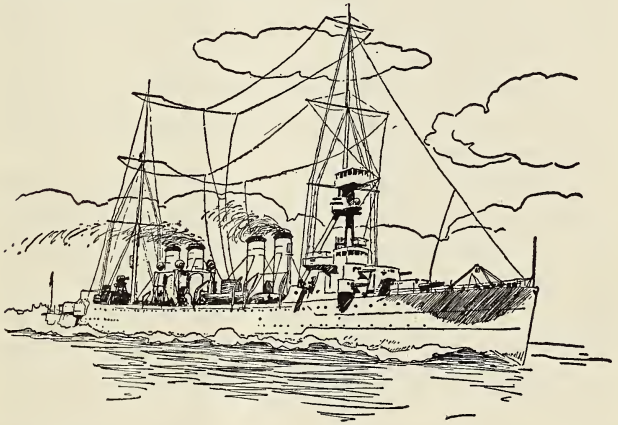
The harbor has its own police force, too. Here and there we catch a glimpse of the swift little launches dashing about, for they patrol the water front much as the police on land make the rounds of the streets.

Before we leave the Battery, we notice a big ship, gray all over, with four smokestacks and two tall masts. We see several turrets with guns projecting from them. We recognize her as one of our navy's new cruisers. She is headed for the Brooklyn Navy Yard, and probably is going into dry dock for a new coat of paint.

Do you know what a dry dock is? After a ship has been traveling back and forth across the ocean for a long time, the underwater part of the hull becomes covered with barnacles and seaweed. The paint peels off in spots, and these get rusty. The ship needs to be cleaned and painted.

For this work the vessel is taken into a deep basin with walls of stone or concrete. This is a dry dock.

At one end are great water-tight doors which can be closed after the ship has entered. Then the water is all pumped out and heavy beams are braced against the sides of the hull so that the ship is held straight and firm. Then the workmen do whatever cleaning and painting are needed.



The Memphis, one of our cruisers. She brought Colonel Lindbergh home after his flight from New York to Paris.

If you should ask the captain of a ship about the most interesting harbors that he has visited, he would certainly name several American cities. He would tell you that New York has the busiest harbor in the world, busier even than Liverpool or London which are the home ports of so many English steamships. He would probably say, too, that Antwerp, Hamburg, Marseilles, Montreal, Bremen, Havre, and Genoa also have harbors that are crowded with shipping.

Can you name the countries in which these cities are located?

If you asked about the most beautiful harbors, the captain would surely mention San Francisco because of its entrance, the Golden Gate, and the mountains on both shores. He would tell about Portland, Maine, where the harbor is enclosed with beautiful wooded islands. Probably, too, he would talk about Rio de Janeiro with the strange mountain named Sugar Loaf close beside the harbor, and about Naples, in Italy, where the smoking volcano Vesuvius rises across the lovely bay.

Probably the captain would speak of some of the seaports that have been made to order. A few years ago Los Angeles in California was only a small inland city, located on a river, to be sure, but some distance from its mouth. The people wished to have foreign commerce, so they annexed the little town of San Pedro, twenty miles away on the coast, and enlarged the harbor there. They made it deeper and built a great breakwater. To its piers come more ocean liners and strange craft from foreign ports than to any other American city except New York. More oil is exported from Los Angeles Harbor than from any other in the world.

There are many good harbors on the Great Lakes. There is an interesting story about the one at Duluth, Minnesota. This city is at the end of Lake Superior. Years ago its harbor was barred off from the lake by a long, narrow strip of land. The people were afraid that only a few ships would come into their harbor because of the long distance around the end of this

strip. They were sure that the vessels would go into the harbor of Superior instead. They made up their minds to dig a canal to connect their harbor with the lake. Every man, woman, and child who could handle a shovel went to work. They dug night and day, and before long their canal was cut. Now ships can enter Duluth Harbor just as easily as they can the harbor of Superior.

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RIVERS MADE BY MAN

Why men have dug canals — A trip through the Panama Canal — The Suez Canal — The first canal built by Americans — The canals of our country today — How canals help commerce on the Great Lakes — Canals in other countries — We visit Venice, a city of canals.

SEEING the canal boats in New York Harbor has made us wonder how canals came to be dug. We know that rivers were used for travel long before roads were built. Canals may well be called rivers made by man. They help boats and ships to overcome obstacles somewhat as bridges help land traffic.

The idea of digging the first canals, two thousand or more years ago, probably came when people thought of how much distance they would save if they could cut through some narrow stretch of land between two rivers. Then they could float their boats and rafts through from one to the other.

This idea was easy enough to work out except in hilly country. Sometimes between two bodies of water there was land with high mountains on it. There was no way of making a way through it so that the water would be all of the same level. It was not until four hundred years or so ago that men learned how to build locks. These are the basins of water that we find in the canals that pass through hilly country. Men have now learned how to build locks so large that they will hold the biggest ships afloat.

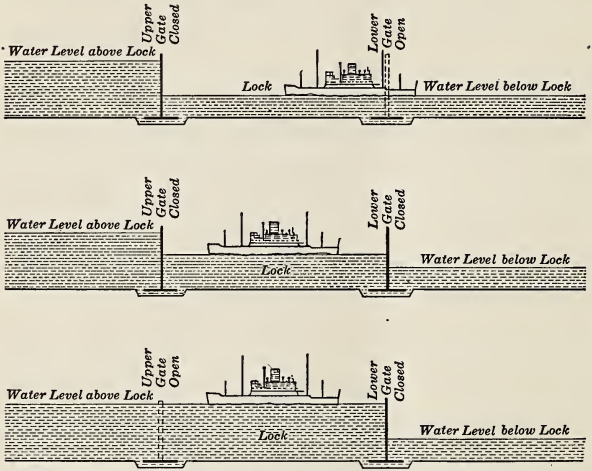
The most wonderful lock canal in the world is the one that American engineers cut through the Isthmus of Panama. Long ago, when Spain owned nearly all of South America, ships from Peru used to sail up

the Pacific Coast to a port on the isthmus. Everything that they carried was unloaded, carried by mules across to the Atlantic Coast over a road hacked out through the forest, and then the goods and treasure were loaded again into ships waiting on the Atlantic Coast. These ships carried the treasure back to Spain. It is no wonder that the Spaniards wished in those days that they could sail the ships that had been loaded in Peru through the isthmus and all the way home. But it was not until quite lately that a canal was cut through the isthmus. Men had to wait long before they found out how to carry ships over the mountains there.

Did you ever hear of a ship being taken up or down a flight of steps made of water? It doesn't sound possible, does it? That, however, is just what happens in the Panama Canal. At three points in this canal are locks which are more like giants' swimming pools set in the canal than anything else we can think of. These locks are arranged to form great steps of water up one side of the mountains and down the other. They had to be made because the work of cutting through the mountains and making a canal on the same level all the way between the Atlantic and the Pacific would have been too much to attempt.

If you have ever played with toy boats in your bathtub, you will understand something about how a lock works. When you let water flow into a tub, your toy boat rises higher and higher. When you pull the plug and let the water run out, your boat drops lower and lower toward the bottom of the tub. If you could join two bathtubs together, end to end,

and could arrange an opening so that water flowed from one tub into the other, you would have quite a good model of two locks.



How a lock in a canal works.

Now let us imagine that we are taking a journey through the Panama Canal. We shall see how real locks work. Our ship steams in at the Atlantic entrance near Colon, a city named after Christopher Columbus, whose name in Spanish was Cristobal Colon. We soon reach the three Gatun locks, where little by little we are lifted to the level of Gatun Lake.

How is this done? First our ship is towed into a lock by big electric locomotives, two ahead to pull and two astern to stop the ship at the right time. These are rack-and-pinion locomotives and they run on tracks beside the locks. Then an immense gate

is closed behind us. This gate is seventy feet high and seven feet thick. It is in two parts each sixty-five feet wide. The gate weighs about four hundred tons, but it is moved as easily as you close the door of your own room. Electric power is used. Accidents are very rare indeed, but if a ship should get out of control, it would be stopped by a great chain stretched across the lock. Each chain weighs twelve tons and its links one hundred and ten pounds apiece.

The lock is one thousand feet in length. At the farther end towers another huge gate. Water from a lake higher up is allowed to flow downhill into the lock where we are. In a few minutes the water, and our ship with it, has been raised several feet. The front gate is opened, and we are towed into a second lock. Again the gates ahead of us and behind us are closed. More water is let in, and we are again raised. This happens once more in the third lock, where we can look back and see below us the tops of trees in the Chagres Valley. Then we find ourselves steaming across Gatun Lake whose surface is eighty-five feet higher than the ocean where we entered the first lock. Our ship has climbed three steps in about half an hour.

We are told the Gatun Lake was formed through the building of a great dam across the Chagres River. Before the canal was dug, there was no lake here, but only a river winding through a deep valley. Now it is the largest artificial lake in the world. At one place it is thirty miles long and twenty miles wide.

While we are steaming across Gatun Lake, one of our fellow passengers, who seems to remember a lot

of history, tells us some interesting things. He says that more than three hundred and sixty years ago the buccaneers attacked and burned some Spanish towns that stood in the valley now filled by the waters of the lake. He says, also, that the old trail between the cities of Panama and Porto Bello ran not far away, and that much Spanish gold and treasure was carried over it on the backs of mules. Perhaps you have read stories about the adventures of Sir Francis Drake on this trail, and at other places on the Isthmus of Panama.

Nearly two hundred years after the days of the buccaneers, American gold hunters sometimes followed the same trail on their way from our Eastern States to the mines in California. At this time an American built the first railroad across the isthmus. That was before the United States had any railroads from the Atlantic to the Pacific. The gold hunters had to cross our wide prairies in wagons, or else they sailed all the way around Cape Horn in the clipper ships that you have read about on page 125. So the railroad that ran about where the canal now runs was the quickest way of getting across the continent.

Much of the way Gatun Lake is bordered by high hills. We pass through the famous Gaillard cut, where the men who built the canal had to blast their way through eight miles of rock and earth. At the deepest part of the cut we see some hills six hundred feet high and others four hundred feet. At most places the channel of the canal is from three hundred to one thousand feet wide, and everywhere it is forty-five or more feet deep. We can easily believe

that immense quantities of rock were taken out. It is said that all the material that was dug out through the whole length of the canal would fill a hole fifteen feet square straight through the earth at the Equator.

At the end of Gatun Lake we begin to go down toward sea level again. There is one lock at a place called Pedro Miguel where we enter another small lake. After passing through two more locks we reach the Pacific. As we go down these water steps, the water is let out of the locks until our ship is lowered first to the level of Miraflores Lake, and then to the level of the Pacific Ocean.

All the locks are built in pairs so that, while ships bound one way are climbing the water stairway, those going the other way are descending it.

The whole length of the Panama Canal is nearly fifty miles. To go through it takes about eight hours. In a busy year, 6500 ships pass through. The distances saved, over the old route through the Strait of Magellan, are very great. For example, a voyage from New York to San Francisco around South America is 13,135 miles long, while a ship going from one of these ports to the other by way of the Panama Canal would travel only 5262 miles.

The Panama Canal was opened in 1914 when a government ship flying the flags of all nations passed through its entire length. This was a symbol of the fact that while the canal is controlled by our country, its use is allowed to all others.

Do you know any other great ship canal? If we were in England and wished to go to India or to Australia, or to China or Japan, what would be the

easiest route? Would we take a steamship all the way around Africa, then across the Indian Ocean and so out on to the Pacific, or could we go some shorter way?

You will find the answers to these questions if you look on a map of Europe and find the Mediterranean Sea. At the eastern end, you will find the Red Sea. There is a narrow isthmus separating these two bodies of water. In the old days ships had to turn back at this point. They can now pass through the isthmus because a canal has been dug from Port Said on the Mediterranean to Suez on the Red Sea. The voyage from England to India by way of the Suez Canal is six thousand miles shorter than the long one around the Cape of Good Hope. Between fifteen and twenty ships usually pass through this canal every day.

The Suez Canal is about one hundred miles long, and it takes a ship about fifteen hours to steam through. It is different from the Panama Canal because it is at sea level all the way. The land around it is flat, bare, and sandy, with no rocky mountains that had to be cut through. The canal is quite straight, and thirty miles of its length consist of small lakes.

You will be interested to know that someone thought of digging a canal to connect the Mediterranean and the Red Sea about seven hundred years before Columbus discovered America. The first suggestion of a canal through the Isthmus of Panama was made by Balboa, the Spanish explorer, a few years after he discovered the Pacific Ocean in 1513.

The two canals that we have been reading about

make short routes for ships traveling between countries on opposite sides of the world. Within the boundaries of our own country are other canals that make it possible for vessels to go from our Atlantic seaports to cities on the Great Lakes. How the first of these, the Erie Canal, came to be dug is an interesting story.

If we had been born in America three hundred years ago, our homes would probably have been in a town either on the Atlantic seacoast or on a river near there. If we had lived to be a hundred years old, we should have heard how people kept moving inland and building new towns either farther up the rivers or on the shores of lakes. In other words, the Pilgrims and the settlers in Virginia and the other English colonies built their homes near where they landed or in places that they could easily reach in boats. People who came many years later went farther west to make their homes.

Most of the country was covered with thick forest. It was a long time before any roads were built. When people traveled, they went by water. The rivers were ready-made roads; while any roads that the settlers made were hard to build in the first place and hard to keep in repair.

As larger parts of the country were cleared, small towns sprang up in the best places. More and more people went to live in these towns, which by and by grew into good-sized cities. A few roads were built, over which pack horses and wagons carried farm produce and all the things that people needed in their new homes. This was before the days of rail-

roads. Sometimes the route between two cities or towns was roundabout, for one or the other of them might be on a river, but not on the main road. Then the goods had to be taken part way by wagons and the rest of the way by boats. People began to ask for routes that would be more direct. They wished to save the money that they had to spend in taking freight out of boats and putting it on wagons, or in taking it out of wagons and putting it on boats.

George Washington was one of the first to see that if man-made rivers, or canals, could be dug to connect two rivers or a river with a lake, it would be easier and cheaper to move people and freight into new parts of the country. DeWitt Clinton, the man whose name was given to the old railroad train that we saw in the Grand Central Terminal, also thought this a good idea. In 1817, when he was the Governor of New York, he persuaded the people of that State to begin a canal that would connect the Hudson River with Lake Erie.

At first, nearly everyone laughed at the idea. They called the canal "Clinton's big ditch." They said that the Governor would spend all the money in the State before he got the canal dug, and that after it was finished it would not do what was expected. They poked fun at him just as other people poked fun at Fulton when he built his first steamboat, the Clermont. This is usually the way when inventions are new. People were shy about riding on the first railroads. The first steamboat on the Hudson River was spoken of as "Fulton's Folly," because few believed that the experiment would ever amount to

anything. Henry Ford, when he drove his first automobile, was told by a policeman to "get off the street." Most people, only about thirty years ago, doubted whether flying machines would be of any use. But all these inventors and a great many others proved that their ideas were right.

Governor Clinton was not discouraged. He went ahead digging his canal. To keep up the interest of the people of the State, he began at the middle and worked toward the two ends, Buffalo and Albany. He was sure that no one would be satisfied to have only a part of a canal halfway between these two cities. After eight years of work by a large force of workmen, the canal was completed. It was 363 miles long and forty feet wide. The water was four feet deep, which meant that boats that did not sink far into the water must be used.

The Seneca Indians lived in this part of New York. In their honor the first boat on the Erie Canal was named Seneca Chief. In October, 1825, Governor Clinton stepped on board this boat at Buffalo. It was gaily decorated with flags and flowers. Four gray horses were hitched to it. Beside the canal was a towpath on which the horses trotted along, drawing the Seneca Chief after them. Every five miles there was a cannon which was fired as Governor Clinton went by. There were crowds of people all the way along, tooting horns and cheering. There were bands and fife and drum corps to help celebrate the great event. Fresh horses took the place of tired ones every few miles. In three and a half days, Governor Clinton arrived in New York City. Per-

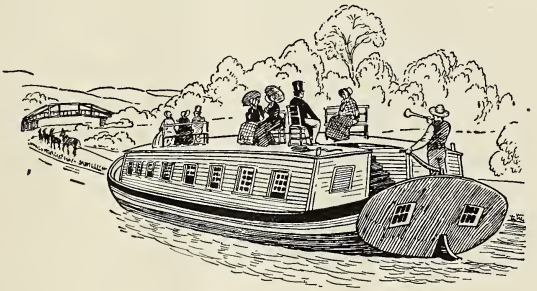
haps no one had ever traveled five hundred miles more quickly than he had.

At the end of the voyage, Governor Clinton stood on the deck of the Seneca Chief and poured into New York Harbor some of the water of Lake Erie which he had brought in a gilded keg. This was a symbol of the great fact that the two bodies of water were now united. Freight could now be taken all the way from the mouth of the Hudson to the shore of Lake Erie by boat.

After this, most of the freight traffic between the East and the West went over the new route. Before the opening of the Erie Canal it had taken three weeks to carry a barrel of flour from Albany to Buffalo, and it had cost ten dollars. Now it took less than one week, and cost only thirty cents. People at last had the quicker and cheaper way of traveling to and from the West for which they had been asking. Within a year after the Erie Canal was opened, thousands of boats loaded with wheat, lumber, and furs came from the western part of the country. And very often as many as fifty boats in a single day started from New York or Albany carrying supplies, furniture, and farming tools to the pioneers around the Great Lakes. If the Erie Canal had never been built, perhaps New York City would have been slower in becoming the great city that it is today.

This old canal has recently been enlarged and extended, and now the New York Barge Canal, as it is called, makes it possible to reach nearly all the big cities of the State by water. The canal boats are towed by steam or motor tugboats.

The old-fashioned canal boats were long and narrow, with blunt ends, and carried a great deal of cargo. They also had cabins for passengers. They did not travel as fast as the Seneca Chief on her first trip, for only two horses or mules were used to pull them. The usual speed was about a mile and a half an hour, and each passenger paid a cent and a half a mile.



An old-time canal boat on the Erie canal.

On pleasant days the passengers sat on deck, enjoying the scenery. Every little while the boat would come to a bridge where a road crossed the canal. Most of these were so close to the water that the captain would call out "Low bridge!" and everyone would have to throw himself flat on the deck to keep from being scraped off the boat. When it was stormy, there was little for the passengers to do except sit in the cabin and read or play games. The roof was so low that tall men could not stand up straight. At night the only beds were mattresses on narrow shelves along the sides of the cabin. Usually there

were three of these, one above another. They were so short that most people had to sleep with their knees drawn up, and they woke up feeling very cramped. In the mornings the passengers got water for washing by dropping a bucket on a rope into the canal. At meal times they all sat around one table, big enough to seat about thirty, which was set up in the middle of the cabin.

The Erie Canal was so successful that during the next twenty-five years many other canals were dug. They were nearly all east of the Mississippi. By 1850, a man could travel by canals and rivers all the way from New York City to New Orleans. Some people began to talk about making a way by water all the way from the Atlantic to the Pacific. But now something happened that put a stop to the digging of canals. This was the building of railroads. This is a story by itself and has already been told in another chapter.

Although the growth of railroads ended for a while the need of new canals, it has been found that both have their advantages. Where time is the important thing to consider, people find it best to send goods by train. Water transportation has the advantage of being cheaper.

There are today several important canals in different parts of the United States. One is the New York Barge Canal, which grew out of the old Erie Canal. In all there are now 780 miles of canals in the State of New York, and nearly half the area of the State is within twenty miles of some waterway, which is connected with one canal or another. You can see how

greatly this helps commerce. These are all lock canals.

There is also the Cape Cod Canal, a sea-level waterway, through which, you remember, we made a short trip from Boston to New York. Altogether, the United States has a total of about 2500 miles of canals in use. Are there any canals in your community?

There are important lock canals in Michigan called the Soo. Their real name is Sault Sainte Marie, which is French for St. Mary's Rapids. The river between Lake Superior and Lake Huron is too dangerous for boats, so nearly eighty years ago a canal was built to carry freight and passengers around the rapids. Since then three other canals have been built to handle the growing traffic. One canal of the same sort has been built in Ontario, the province of Canada just across the river. All these canals together now carry three times as much traffic as the Panama Canal, and more than the Panama and Suez canals combined. They are busy day and night from early in the spring until late in the fall. During the winter they are closed by ice. If you have visited Niagara Falls, perhaps you have seen the Welland Canal. This has the longest locks of any canal in the world. It was built so that vessels could get around the falls.

An endless chain of ore and grain boats travels to and from the many ports of the Great Lakes during the eight months of the year when the water is open. Those bound eastward are known as down-lake boats and carry for the most part iron ore, copper,

lumber, and grain. The up-lake or westward-bound boats are loaded with machinery, automobiles, coal, groceries, house furnishings, and dry goods. Can you explain the reasons for these different kinds of cargoes?

If you ever visit the harbor of Duluth, at the far western point of Lake Superior, you will have an interesting time watching the loading of the steamers. It is said that this city, like others on the Great Lakes, has some of the best arrangements for handling freight in large quantities that are found anywhere in the world. Huge cranes lower buckets into freight cars standing beside the piers, scooping up a ton or two of grain as easily as a chicken picks a kernel of corn from the ground.

There are also powerful derricks that can pick up a car full of ore, swing it out over a steamer, and turn it over so that the ore is dumped into the hold of the ship through openings called hatches. Then the empty car is turned right side up again, placed back on the track, and moved away. The derrick picks up the next car and pours its load of forty or fifty tons of ore into the ship. It does not take many minutes to empty a whole train in this way.

Then the vessel takes its load across the lake, through the Soo canals, and on to some distant city. If there were no Soo canals, the transportation of freight by railroad to and from the Eastern States would be much more expensive than it is.

In the newspapers we are likely to read quite often about the St. Lawrence Waterway. When this is finished, it will be possible for ocean steamships to

go to Cleveland, Duluth, Chicago, and other ports on the Great Lakes. This is a strange thing to think of, for the map shows us that these cities are far from the Atlantic Coast.

The St. Lawrence River, however, has deep water for a long distance. And when a ship once gets into any of the Great Lakes, she can steam along just as she can on the ocean. At three places canals will be built around rapids, and so one lake will be connected with the next one. Then there will be a deep-water route for big ocean liners all the way from Europe into the center of North America.

A worth while project for you would be to find out about the canalization of the Mississippi and Illinois Rivers. The dams and locks that have been built and the channels that have been deepened make it possible for steamers from Chicago and other large inland cities to go all the way to the Gulf of Mexico. Think how much this helps the commerce of the central part of our country.

You should learn also about the canal around the rapids of the Columbia River, in Oregon, two hundred miles or so from its mouth. Vessels from the Pacific coast can now travel by means of this river and the Snake River as far as Lewiston, Idaho. This is a great help in the transportation of the wheat and apples, and the lumber, lead, copper and silver produced in the surrounding States.

In countries where there are not so many railroads as there are in the United States, canals and rivers are a very important means of travel. You can go all the way across Sweden in canal boats. France,

which is not quite so large as the State of Texas, has more miles of canals than there are in our whole country. Canals connect the principal rivers, and you can go by water across France from the Mediterranean Sea to the Bay of Biscay. In Holland and Belgium canals are almost as common as roads. In some of the chief cities, like Amsterdam and Bruges, many of the streets are canals. From the cities, canals stretch out in all directions into the country. Nearly all the freight is carried by boats. You will even see loads of hay on broad flat-bottomed scows moving, as it looks from a distance, right through the fields. Sometimes a canal boat is the only home that a family has. It is neatly painted, and you see small flower and vegetable gardens growing in boxes on the deck. There are curtains at the cabin windows, and dogs and cats play about with the children, just as if they were living in a house.

China is said to have as many miles of rivers and canals on which sampans and other small boats can go as we have miles of railroad lines. The longest canal was dug many hundreds of years ago. In all it is six hundred miles in length, but for long distances it is so filled up with sand that it can be used only in the wet season when the whole country is flooded.

In all China there are only about eight thousand miles of railroad. The United States has more than thirty miles to each one in China. There are also very few good roads, as you have read. People have to travel mostly by boats, but they can do this because there are so many rivers and so many canals

connecting them. The country seems to be covered with a network of waterways.

Perhaps, when you think of canals, you think of none of those that you have just been reading about. Instead of these, you think of the canals of Venice, that beautiful city in Italy. Doubtless you have seen many pictures of the canals there.

There is no place in the whole world like Venice. For one thing, almost nothing there goes on wheels because there are no real streets. Venice is built on a group of about one hundred little islands, and the water between them makes the streets. Steamboats take the place of trolley cars. Boats, called gondolas, are used instead of automobiles and taxicabs. Instead of motor trucks, there are big scows that carry meat, fish, vegetables, bricks and mortar, or freight. The principal canal, named the Grand Canal, winds through the city like a capital *S*. Of course there are some paved streets in Venice, but they are much like what we should call alleys. They are very narrow. It is very rare to see a horse there, or even a bicycle.

When we go to Venice, we shall probably arrive in a train, which runs over a long bridge built out from the mainland. Then we walk through a railroad station not very different from an American station, and come out on a broad space which extends to the edge of the Grand Canal. There we find a great crowd of men with their gondolas waiting to take people to their hotels or homes. We choose a man wearing a neat white blouse, dark trousers, and a bright sash, and step into his boat.

The gondola is long and narrow, and painted black. It is shaped like a huge canoe. Only the middle part touches the water. The bow curves gracefully upward, and at the top is a shiny metal ornament that reminds us of an old-fashioned battle ax, of the sort known as halberd. The two ends of the gondola are decked over, and at the center is a little covered place something like the top of an automobile, with a carpet and chairs. On the stern stands the man who rows the gondola. This part curves up like the bow, but not quite so high.

A gondola of Venice. In the distance we see some palaces and the campanile, or bell tower.

The boatman, who is called a gondolier, stands up to row, and he uses only one long oar. Instead of a rowlock, there is a queerly shaped piece of wood, as big as the stump of a small tree. It is carved somewhat like the small end of a violin. The gondolier rests his oar in one of the grooves and pushes the boat

along — working more like the men we see at home sculling a punt or a dory than anything else we can think of.

We shall enjoy our ride in a gondola, for the Grand Canal is lined with beautiful old palaces and churches. Some of these have carved marble balconies and window frames. Their walls are often pink or yellow. In front of hotels and large houses, gaily painted posts stick up out of the water with empty gondolas tied to them, waiting for passengers. We pass under a famous old bridge named the Rialto on which we see shops filled with flowers and all sorts of things. Here and there are gardens and parks with shady trees.

There are many side canals with little bridges over them, running out of the Grand Canal. It is said that there are nearly four hundred bridges in Venice. Perhaps our gondolier will take us through some of these smaller canals. If he does, we shall hear him sing out a word or two as he approaches a corner. This is to warn other gondoliers that he is coming, and we may hear another gondolier answer ours. Even if we do not understand the words, we think that this way of signaling is much more interesting than the honking automobile horns at home. Along the side canals, most of the houses have boxes of flowers in their windows and perhaps cages of singing birds.

Soon we arrive at the place named the piazzetta, which means the little square. This is near the end of the Grand Canal where there is a wide harbor called the lagoon. Here the water is deep enough for

ocean liners and steam yachts, and we see several lying at anchor. We see also many little fishing boats, whose red sails look very pretty against the blue sky.

Venice is famous, not only as a place for travelers to visit, but because it used to be one of the world's busiest seaports. Marco Polo, the great traveler of long ago, who brought home wonderful stories about China, lived in Venice. It was the home also of John and Sebastian Cabot, the sailors who, soon after Columbus, made a voyage to America for the King of England.

Long before Columbus discovered America, the fleets of Venice carried most of the commerce between Europe and the Far East. These ships sailed through the Mediterranean Sea as far east as Constantinople and to the Isthmus of Suez. There they were loaded with the goods that came from China, India, and Persia by caravan. Then they made the voyage back to Italy and to other parts of Europe.

After new water routes to the East were found, the commerce of Venice grew less because Spain, Portugal, and later France and England got control of the carrying trade. After the discovery of America, the Atlantic became the great ocean highway of the world just as it is today.

The story of Venice helps us to understand the importance of ships and sea routes to any country that hopes to have a generous share in the world's trade.

WHAT TO READ

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Chapter XIII. Joining Two Oceans.

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Chapters I. On the Canals of Holland; III. In a Gondola.

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Chapters XVI. Canals and Waterways; XVII. The Panama Canal.

PASSENGER LINERS AND FREIGHT SHIPS

We explore an ocean liner — When a steamship arrives from abroad — Why cargo liners are important — How bananas are brought to us — A tramp steamer's wanderings.

WE ARE all proud, as we ought to be, of the splendid new steamships flying our country's flag. Nowadays we see them in our seaports almost as often as ships belonging to other countries.

One of the most interesting experiences for any boy or girl is to go aboard one of them and explore its mysteries. Some time, no doubt, we shall take a trip abroad to see famous cities and to learn how the people of other countries live. Before we do this, we should ask some officer of a big ship to take us over her, so that we can see the most important things, from the boat deck to the engine rooms. Thus we shall learn a great deal about how ships are built and what makes them go. When we sail on our voyage, we shall feel quite at home on shipboard.

Before we visit a liner, we should know a few of the names that sailors have for her different parts. We go aboard over a gangplank, or long narrow board walk which slopes from the pier to one of the decks. A real sailor never talks about going upstairs, and he doesn't speak of the ends of the ship as the front or the back. A staircase on a ship is a companionway, and the two ends are the bow and the stern. When we face the bow or forward end, the side at our left is port, and the right-hand side is starboard. When a sailor says aft, he means toward the stern.

Our ships go to hundreds of foreign ports. What American lines do you know? To what one does this ship belong? In what country is this harbor?

The port side of a vessel carries a red light at night, and the starboard side carries a green one. Perhaps you have seen automobile trucks or taxicabs that do this. Sometimes, however, men who do not know the ways of the sea put their colored lights on the wrong sides. This does not cause trouble on land, for probably most people do not know what the lights mean anyway. But on a dark night at sea, sailors can sometimes tell which way another vessel is going only by noticing whether they see a green light or a red one. The port and starboard lights help vessels to keep out of each other's way.

Liners have several decks that are marked with letters, "A," "B," "C," and so on. Perhaps on the largest ships there are as many as seven or eight. These are all above the water line. The part of the ship that contains "C" deck, and the lower decks, "D," "E," and "F," is usually painted black, but two or three steamship lines paint the hulls of their vessels white or gray.

Along the sides of the hull run several rows of little round windows, which we must be sure to call portholes. There is a row for each of the lower decks, and when the ship is at sea, the portholes often have to be kept closed, so that the waves or spray will not come in.

Below the water line, most ships are painted red. We may see a narrow strip of this color when there is not much cargo aboard, for then the ship floats higher out of the water. In this bottom part are the holds in which the cargo is stored, the spaces for the coal or oil used as fuel and for the food needed on the

voyage. Farthest down of all are the great engines with their huge fire boxes and boilers.

No two ships are exactly alike, so we cannot say the "C" deck is always the main deck. Very often, however, this letter is given the topmost deck that runs the whole length of the ship. Most probably, then, after we go from the pier up the gangplank, we shall find ourselves on "C" deck. Upon it is built the superstructure, which contains most of the public rooms and many of the best staterooms. The superstructure is usually painted white or light gray, perhaps with buff trimmings.

Above this deck, too, rise the foremast near the bow, and the mainmast near the stern. Modern steamships do not have sails on their masts. They use them for carrying lights, flags, and signals and as a support for the radio antennæ. High up on the foremast is a little closed-in platform known as the crow's-nest, where a lookout always stays when the ship is at sea. On both masts are booms and tackle worked by little engines known as winches, to load and unload cargo. The openings in the deck through which the cargo and the passengers' baggage are lowered into the holds or hoisted out are hatches.

Forward, on "C" deck, we see the great windlass which handles the anchor. When a vessel hoists her anchor, sailors say she weighs it. Another word, pronounced "way," is used when a ship is moving. Then she is said to be under way.

The deck next above "C" deck is marked with the letter "B," and the one above that is "A" deck. The officer who is acting as our guide takes us up

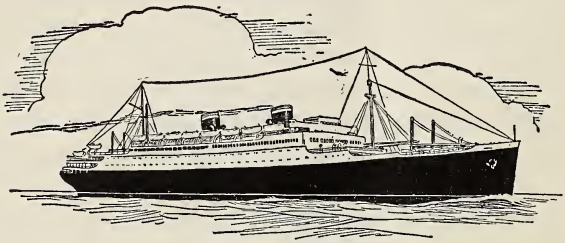
companionways, running through these two decks, and then up another to the boat deck. This is so high in the air that we can look down on the roof of the pier beside the ship. You will see the reason for the name of this deck later on. Through the central part of this deck rise the smokestacks or funnels. They reach, of course, way down to the bottom of the ship, where the engines and boilers are.

The fuel burned under the boilers to make steam is either coal or oil. Years ago it was always coal, but now more and more ships burn oil. Some ships have engines that do not work by steam at all. They are called motor ships, and their engines work more or less like the engines of an automobile. Instead of gasoline, however, a special kind of oil is used as fuel. A motor ship looks very much like a steamship. In fact, almost the only differences that you notice, unless you go into the engine rooms, are the funnels. These are usually shorter and wider than the funnels of a steamship. Sometimes a motor vessel has only one funnel, instead of the two or three that most liners have.

We can tell the name of the company to which a ship belongs after we learn the meaning of the colors or marks on the funnels. Some steamers have funnels of red, white, and blue. These, as we learned when we saw the Washington, are American and belong to the United States Lines. Others have red funnels, with a band of black at the top. These belong either to the Cunard Line, which is English, or to the French Line. This sounds as if the ships of the two lines had funnels exactly alike, but really there

is quite a difference in the way they slope or rake, and in the spaces between them. Also, if we look closely, we shall see that the funnels of the Cunard Line have two or three fine black lines part way down the red part.

The steamships of the Grace Line, which is an American line whose ships go to different parts of North and South America, have green funnels. At the top are narrow bands of black and white.



The new American steamship Washington. She and the Manhattan are twin sisters.

On the steamships of the Italian lines the funnels are unusually pretty. They have stripes of the national colors at the top, red, white, and green. The lower part of the funnels is white. Steamships of the Canadian Pacific Line have buff funnels.

Many companies use black on their ships' funnels because the color does not show stains made by the smoke. To tell their ships apart these lines put different letters, or a circle, a star, or some other mark on the funnels. How many different marks and colors have you seen? Can you tell what the Dollar Line uses? Or the Red Star Line?

Standing up above the boat deck are also several big ventilators, which look a little like the old-fashioned loud-speakers of talking machines or radio sets. These carry fresh air to all the rooms in the ship.

Along the sides of the deck are rows of lifeboats, and the davits by which they are lowered to the water. Every ship carries as many boats as would be needed to take off all the passengers and crew in case of disaster. The largest ships can carry about five thousand persons in all. A good-sized lifeboat will hold sixty persons, and the larger ones eighty or more, so you see there must be many such boats on any big ship.

At the forward end of the boat deck are cabins for some of the officers, and the radio room where the operator receives and sends messages. The radio brings the news from shore, so that a little newspaper can be printed on the ship day by day. The passengers thus know about the important events all over the world just as if they were at home. Messages sometimes are received from ships that need help. Once when Captain Fried was in command of the President Roosevelt, he was called by an English ship that had been wrecked by a storm. He was able to save twenty-five men. Another time, when he was captain of the America, he rescued from an Italian ship thirty-two men who would otherwise have been drowned. Once again, when he was in command of the George Washington, he answered the S O S of an American vessel, and took aboard his ship, a sailor who was so ill that he would have died unless he had been cared for by a doctor. S O S, as

you probably know, is the signal that ships send out by their radio when they need help. It often saves many lives.

Much of the space on the boat deck is used by the passengers for playing such games as deck tennis, deck golf, ring-toss, and shuffleboard. It is a pleasant place, too, for people to sit in their steamer chairs, for here they can get a wider view out over the ocean than from anywhere else on the ship. The higher we are above the water, of course, the farther we can see. Sometimes when we are out on the ocean, we look off, and on the horizon we spy a cloud of smoke. Before long the masts and then the funnels of another steamer come into view. She is then said to be hull down. Can you explain why, when a ship is as far away as that, we see her upper parts first?

After we have looked around on the boat deck, we go down to "A" deck. Another name for this one is the promenade deck, because it has long wide spaces where the passengers walk. On some of the largest ships, if we walk the whole distance around the promenade deck about five times, we cover a mile. "A" deck has space for outdoor dancing, and plenty of room for rows of steamer chairs where we may sit and watch the sea. Parts of this deck have sliding partitions along the sides, or rail, so that in stormy weather the wind, rain, and spray can be shut out.

At the forward end of "A" deck is the captain's bridge. This is a narrow open gallery running all the way across the ship. Officers walking back and forth here can see the whole vessel from bow to stern.

They can also look far out on the ocean in all directions.

Next is the wheel house. Inside are many things that are important to the safety of the ship. There is the steering gear itself where the helmsman watches a compass and turns a wheel to right or left, whichever way may be necessary to turn the vessel or to keep her on her course. Chains connect this wheel with the rudder at the stern of the ship. The steering gear works by steam, but in the old-time sailing ships, the rudder was turned by man-power. The wheel was at the stern, over the rudder.

When a ship is under way, a dial in the wheel house shows her speed. It might read "20 knots." This would mean that the ship was traveling at the rate of twenty sea miles an hour. This is faster than twenty miles an hour would be in an automobile, for a sea mile is about one and one sixth times as long as a mile on land.

In the wheel house there is a "telegraph" by which orders are sent to the engine room. We see that it has a round dial like a clock. The captain turns a lever which moves a pointer to the command he wishes to give. There is another dial in the engine room just like this one. The telegraph rings a bell to attract the engineer's attention. He looks at the dial, does what the captain's signal says, and moves a lever which repeats the order back to the bridge. Thus the captain can be sure that his order has been exactly followed.

There are also telephones that connect the wheel house with all parts of the vessel. There is a button

to press when the captain wishes to blow the ship's loud, hoarse whistle, and a lever with which he can work the searchlights on the top of the wheel house. On the wall is a picture of the ship in outline, with every part numbered. Here a light gives warning if a leak or a fire breaks out. The captain can instantly send men to make repairs or to fight any small blaze before it grows to a big one.

Connected with the wheel house is the chart room. Here are the maps and instruments that the officers use in guiding the ship. Here also is kept the daily record of the voyage. This is known as the log because the speed of the ship, hour by hour, is one of the facts that is always written down. Log is a word that comes from the old days, and means a machine that measures the speed.

Everything that we have told you about the bridge, the chart room, and the wheel house has to do with the safety of the ship. There are a great many other things that might be explained, but it is time to go to the other parts of the ship and see how the passengers are made comfortable and happy.

The newest and best liners, like the Manhattan and the Washington which were recently built for the United States Lines, are really a good deal like hotels. When we look into the lounges, the dining rooms, the libraries, and the other rooms where the passengers gather, we find it hard to believe that we are on a ship. The carpets and the furniture are just like those in hotels ashore. There is a smoking room which has a real fireplace. On chilly days real logs blaze in it brightly. There is a little theater, with a

screen for talking pictures. There are rooms for dancing and for playing games. Everything is done to make passengers, both grown people and children, feel at home. Your father would enjoy the gymnasium where there are rowing machines, electric horses that trot or gallop, bicycles, boxing gloves, Indian clubs, and most of the other things used in a gymnasium ashore. And wouldn't you enjoy them yourself!

Then there is the children's playroom, where there are games and toys of all kinds, an aquarium, and even a live canary. Outside this room a part of the deck is fenced off for the use of the little children, who can play here in the bracing sea air and sunlight. Here are sand boxes, slides, and plenty of things like those in your playground at home. Near-by is a kennel for dogs whose masters are taking them on a trip to Europe. There are separate little houses for twelve dogs, and your four-footed friends are as well cared for as they would be at home.

The Manhattan has interesting pictures on her walls. In one of the dining rooms are paintings of beautiful old ships with all their sails set. One of the smoking rooms has pictures of an Indian camp, a buffalo hunt, and Indians on the war path. Another has paintings that show the caravels of Columbus at sea, the landing of the Pilgrims, and a party of pioneers on their way to the West in their covered wagons.

The swimming pool has a blue floor and blue sides, so that it looks like the deep ocean. It is decorated with pictures of starfish, flying fishes, and sea horses.

In the children's playroom are pictures of Alice in Wonderland, Aladdin and the Wonderful Lamp, the Pied Piper, Puss in Boots, Little Red Riding Hood, Jack and the Beanstalk, and other friends out of your story books.

A liner's bedrooms are known as staterooms, or cabins. Only a few years ago they were very small and had the plainest sort of furniture. Along one wall were two narrow berths, one above another, like those in a Pullman car. The washstand folded up when it was not in use. There were no closets for clothes. On the Manhattan, there are real beds in every single one of the staterooms. The Cabin Class rooms are the most expensive and they have prettier furniture than the rooms of the Tourist Class or the Third Class. But every room on the ship is attractive. Each has running water, both hot and cold, a good-sized wardrobe, an electric fan, and an electric heater. A person who would want anything better in his own home would be very hard to suit. The United States Lines publish a folder containing many colored pictures of the Manhattan, which give the best possible idea of the beautiful public and private rooms on this fine new ship. You may be able to get a set of these pictures at the office of some company that plans voyages for travelers.

The arrival of a liner from across the ocean makes a great deal of work for a great many people. It usually takes a week or more to get everything ready for her to land her passengers and freight.

First the dock which the vessel is to occupy is decided upon, and then a crew of men starts clearing

and arranging it. The pier is as busy as a beehive while this is going on. Sometimes as many as five hundred signs have to be posted at different places on the pier. Some of these tell the people, who will come to meet friends on the ship, how to find their way about. Others show where the passengers' baggage is to be placed. Each person will find his own, after it has been taken out of the ship, under the sign that shows the initial letter of his last name. Still other signs guide people to taxicab stands, telephone booths, and telegraph desks.

When the ship sails from her port on the other side of the ocean, the captain sends a cable message to the American officers of the company. This tells whether the ship has any freight that needs special handling, so that the necessary plans can be made. If any of the freight is unusually heavy, floating derricks to lift it from the hold must be on hand. The ship's own booms can handle a weight of about five tons at one hoist. Sometimes a piece of cargo weighing fifteen tons or even fifty tons has to be taken ashore. To move it, the stronger machinery on a floating derrick must be used. The message from the captain tells also how much coal or oil will be needed as fuel for the return voyage, so that it may be ready for loading.

All the way across the ocean the ship keeps sending radio messages to the company. These tell how near port she is getting, and whether she has been delayed by storms. They help the people on the dock to get their work done in plenty of time.

Two or three days before the liner comes in, the

telephone operators on the pier begin to be very busy. Everyone who has a friend aboard wants to know when the ship will dock. Sometimes as many as five thousand telephone calls are answered during these last few days.

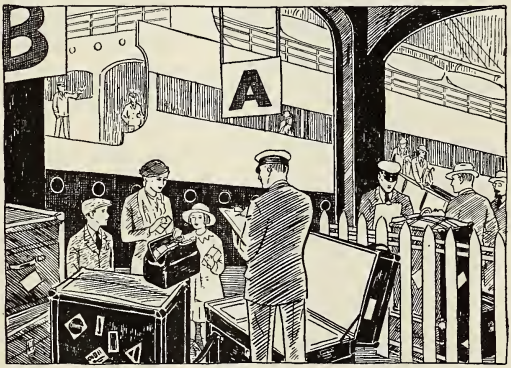
The company has a big bulletin board in its office, something like the one that tells about the arrival of trains in a railroad station. The news from the incoming ship is posted on this. At last comes the news that the ship will arrive at a certain hour on a certain day. The gangs of stevedores, the men who unload ships, are told to be ready. Some of the men are picked to work on the decks, passing goods out of the hold. Others are chosen to work on the dock, handling the cargo as it comes ashore.

A few hours before the ship is due, a red flag is placed at the end of the dock. This warns lighters and barges to keep out of the way. On the day of the ship's arrival, the American flag and the special flag of the company, which is known as the house flag, are hoisted in place of the red one, to show the liner's captain where he is to dock. These two flags are hauled down when the ship comes close to the dock.

The liner is taken into the dock by tugboats, some pulling her bow and others pushing her stern. All these boats are ready some little time before the liner arrives, and wait for her near the end of the dock. At last she steams slowly up. The tugboats fasten their ropes, or lines as sailors call them, to her. The liner stops her engines, and the tugboats pull and push until they have the liner safe at rest in just the right position.

A big door in the side of the ship is then opened

and the gangplank is put in place. The passengers file ashore, sometimes as many as two thousand of them. The pier is crowded, for perhaps there are two thousand other people waiting there to welcome these travelers. Porters rush here and there moving trunks and small baggage. There are dozens of messengers with telegrams or letters, and agents for railroads and hotels who have been sent to meet different passengers.



The end of an ocean voyage. Each passenger's baggage is placed under a sign marked with the letter that begins his last name.

The customs officers are busy looking over the things that the passengers have brought home from abroad. There are some things, you know, that can be brought into this country only if the people who are bringing them are willing to pay the Government a small fee, or customs duty.

All plans have been made so carefully for the landing that everything goes like clockwork. In a sur-

prisingly short time all the passengers have come ashore, and it does not take very much longer to unload the tons and tons of freight from the ship's holds. Then the new fuel is put aboard, new cargo is loaded, and the ship is made ready for another voyage.

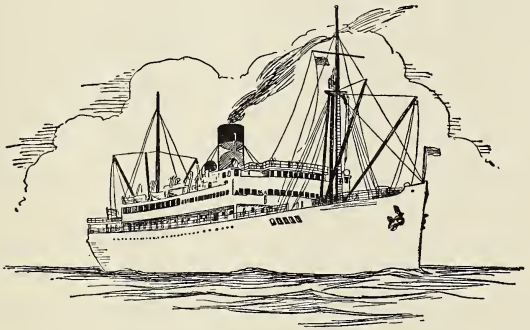
The big passenger liners are the showy vessels among merchant ships. They are wonderful to visit and more wonderful still to travel on. For our daily needs, however, we depend more on the cargo liners. These are smaller vessels and carry mostly freight, with only a few passengers.

When you go marketing with your mother some day, see whether you can tell the parts of the world from which different foods come. Many, you will discover, are brought from lands far across the ocean. If there were no cargo liners, no tramp steamers, and no sailing vessels, we should have to get along without some of our favorite fruits. Bananas, for example, come from Central America or the West Indies, pineapples from Hawaii, coconuts from the West Indies or the Philippine Islands, dates from northern Africa, and figs from Turkey.

Your mother would find it hard to keep house without the spices that steamships bring from the Far East, and the sugar that they bring from Cuba or Hawaii. She would miss her coffee from Brazil, and her tea from India, China, or Japan. Spain sends us olives, Argentina sends corned beef, and Alaska sends canned salmon. Cod and other deep-sea fish are caught off the coast of Newfoundland and New England and brought to Boston, Gloucester, or some other

port by little vessels called schooners. This is quite a long list of things brought to us by ships, but we are sure that you can easily add to it.

Interesting stories could be told about the travels of many of our everyday foods. Here is one about how bananas come from Central America and the West Indies. This fruit is imported at many ports on the Atlantic, the Gulf of Mexico, and on the Pacific. New Orleans receives about 23,000,000 bunches a year, and is the greatest banana port in the world. Bananas are used all over the United States and Canada. In the summer they find their way even into the northland beyond the Arctic Circle.



One of the steamships that bring us bananas.

All banana-carrying steamers contain several decks. If there are four decks, they are called upper 'tween deck, lower 'tween deck, orlop deck, and lower hold. If there are only three, they are 'tween deck, lower 'tween deck, and hold. On each deck there is re-

frigerating machinery so that the bananas will not ripen too fast during their voyage. They are picked while they are green and before they are fit to be eaten raw. Each deck is divided into a number of bins. The sides of the bins are made of planks, with spaces between, so that fresh air may circulate all the time. Big fans keep the air moving. To avoid chilling the fruit during cold weather at sea, there are steam pipes to supply heat when it is needed.

At most ports, the bunches of bananas are passed into the ship by loading machines, called conveyors. These have endless chains to which canvas pockets are fastened, and they work so fast that 75,000 bunches can be put aboard in about fifteen hours. This makes a shipload. It would fill between seven and eight trains of sixty cars each. That is the usual number of cars in a banana express train in the United States. Sometimes bananas are loaded into a ship by hand. Long lines of men and women, each with a big bunch of bananas on his or her head, pass back and forth between the banana cars on the pier and the side of the ship. When the work is done in this way, it may take all day and all night to get the vessel loaded.

The bananas have been sorted carefully so that all of the same grade are together. The bunches are stowed with little spaces for air between them, some standing on end and some laid flat. During the voyage, men walk through the holds of the steamer every few hours, day and night, to make sure that the temperature of the air is just right to keep the fruit in the best condition.

As soon as the banana steamer gets within a hun-

dred miles or so of the port to which it is bound, a radio message is sent to the fruit company's office. This tells the name of the ship, the number of bunches in the cargo, the hour when she expects to dock, and the pier where she will tie up. The fruit company sends this information to the railroads and they arrange to have the needed number of cars waiting at the pier when the ship arrives. Bananas spoil rather quickly, and this is the reason why so much care is taken to handle them promptly when they arrive at one of the ports.

Wherever we go to watch the unloading of a banana steamship, we shall find a crowd of people watching eagerly. There are two especially interesting ways in which this work is done. At New Orleans we shall see unloading machines much like the ones that do the loading in Central America. They are movable conveyors that run on tracks and can be pushed alongside a ship tied up at the pier. Usually two of these machines work at the forward hold, and two aft.

Each conveyor starts its endless chain moving. The pockets are filled with bananas in the hold of the ship. As fast as the chains turn, the fruit is lifted out of the ship and carried over to the other side of the pier. There the pockets gently empty their load upon another endless chain. This one is long and flat like a belt, and runs across the end of the conveyor. Straw mats are laid upon it to keep the bananas from being bruised. The belt carries the bunches of bananas to the doors of refrigerator cars waiting on a track near-by. As soon as the whole train is loaded, it is rushed away with a supply of

fresh bananas for distant cities. A banana express train is given the right of way over any other fast freight, and sometimes even over United States mails.

The other way of unloading bananas is by hand. Probably it will be given up everywhere soon, for machinery works much faster than men can. If, however, you are ever in one of the smaller seaports when a banana steamship comes in, try to see this interesting sight. Many stevedores take their places in the hatches of the steamer, some on the upper and some on the lower decks. The fruit is passed from one man to another. It is taken out of the ship both through the hatches on the main deck and through wide spaces that can be opened in her sides. To hurry the unloading, bunches of bananas are handed out from both sides at the same time. A line of men on the wharf take the bananas from the men on the ship, sling them on their shoulders, and walk across to the waiting cars, trucks, or wagons. On the off-shore side of the ship, the fruit is unloaded into railway cars on huge floats close beside the vessel. These floats, when loaded, are towed to the shore and the cars are made into trains.

The ships that bring bananas and other fruit from the tropics belong to the United Fruit Company. They run back and forth between certain ports on a regular time-table, just as passenger liners do. Oil tankers work in this way, too, and so do many other freight carriers.

There are hundreds of freight ships, however, that never enter the same port twice in a year. They are sent all over the world wherever their owners

can find cargoes for them to carry. They are known as tramp steamers because they seem to have no home. This name is not really a fair one because these ships probably work harder than any others afloat. If we see a ship that looks shabby and rusty and that seems to need a thorough cleaning, we must remember that tramp ships seldom stay in one place longer than the time it takes to unload one cargo and load another. Often these cargoes are dusty, dirty ones. No matter how hard the sailors try to keep the paint clean, the ship soon gets grimy. Only once in a great while can a tramp ship go into dry dock, for the repairing that other vessels get regularly.

If we should talk with a sailor on a tramp ship, he could give us a very good idea of the way these vessels wander about. Perhaps his ship took on a cargo of coal at Philadelphia, and started for Buenos Aires. When she reached there, she found that her owners had sent orders for her to go to Chile after leaving her coal, and load with nitrate. This was taken to New York, to be made into fertilizer for use on American farms.

The next cargo, made up of steel rails, was put aboard at New York. The ship went through the Panama Canal and across the Pacific to Yokohama, Japan. There she received by cable a message from her owners that she was to go to Calcutta, India, where a cargo of jute was waiting for her. This she carried to Dundee, Scotland, where part of it was made into burlap and part into rope. Finally the good old ship steamed around to Wales and filled the holds with coal. Then she came back to the

United States. She unloaded at Boston, and afterward, no doubt, was very happy to go into dry dock for repainting and a general fixing up.

If on a map of the world you draw lines that show the voyages of this tramp ship, you will find that in a single year she crossed nearly all the oceans and visited most of the continents of the earth.

WHAT TO READ

The Book of Ships. Ernest Protheroe.
Part II. Chapter V. Life on a Liner.

The Book of the Sea. T. C. Bridges.
Chapter XIII. Floating Cities.

The Book of the Ship. G. G. Jackson.
Chapter XVI. Running a Big Liner; XXVI. The Motor Ship.

Full Steam Ahead! Henry Lent.
An account of a six days' voyage on an ocean liner.

The Lookout Man. D. W. Bone.
Chapters II. The Great Ships; III. Mail Liners; IV–V. Cargo Liners; VI. Tramp Steamers; VIII. Oil Tankers.

The Picture Book of Ships. Peter Gimmage.

The Romance of a Modern Liner. E. G. Diggle.
Chapters V. Wireless; VI. The Floating City.

The Romance of the Merchant Ship. Ellison Hawkes.
Chapters X. Transatlantic Liners of Today; XIV. Cargo Ships and Oil Tankers; XV. Refrigerator and Other Vessels.

The Ship Book. Dukelow and Webster.
The First Part tells about "Ships and What They Do"; the Second, "Ships and How They Came to Be"; and the Third, "What All Young Sailors Should Know."

SHIPS OF OTHER DAYS

How boats began — Canoes of the Indians — Eskimo boats — Rafts, the simplest boats of all — Koofahs and balsas — Chinese junks and sampans — How the ancient Egyptians made their boats — The galleys of the Mediterranean peoples — Viking ships — The ships of Columbus — American sailing vessels — How steamships came to be.

NOW let us go back to the time when men first discovered how to travel upon the water, and see what we can find out about how boats began and what they grew to be like in later ages.

No one knows when or where the first boats in the history of the world were made. It was certainly thousands of years ago. No one knows who made them or exactly what they were like. We can be sure that they were very simple and that they were made from whatever materials were near at hand. Travelers who visit far-away places today, where the people have no way of building boats like ours, see native boats that may be very much like the ones used when men first began to travel on the water.

Perhaps the first man who built a boat did it by hollowing out a log. He had no saws or axes like ours, so he probably used fire and sharp stones. We may suppose that first of all he found a fine big tree in the forest. Then he built a fire at the foot of the tree, and kept it from spreading upward by splashing water on the trunk. He made the fire burn through the bark of the tree close to the ground and after that through the tree itself. When the tree fell, the man burned off the branches, and also burned the trunk in two. In this way he made a log, just the right

length for his boat. Next he gave the ends a pointed shape, so that the boat would move more easily through the water.

The next step was to hollow the log out. Branches were laid along the top and set afire. Again the man kept the blaze from burning too much of his log by drenching the sides and ends with water. Every now and then he would chip out pieces of the inner wood with sharp stones. When he had hollowed out a good deal, he poured in water into which he dropped hot stones. This would soften the wood and make it easier to dig out.

Finally the whole log would be hollow. The boat builder would put in some stout cross-pieces of wood to keep the boat in shape. At last he would drag his boat to the water, launch it and paddle it along in the water. Imagine the pleasure with which this first boat builder would survey the results of his ideas and his labor!

Boats are still made in very much this way in some parts of the world. They are called dugouts. Indian tribes in Central America often make boats of this sort as much as thirty-five feet long. We can see one of these when we visit the Museum of the American Indian in New York City.

Along the Congo River in Africa, the natives make even larger ones. Once in a while a traveler sees a dugout long enough to carry forty or fifty paddlers and wide enough for four or five people to sit side by side.

Boats of another kind, too, were built hundreds of years ago by uncivilized people such as the American

Indians. Dugouts, of course, were very heavy. If a party of Indians launched their dugout on one lake and then wished to use it on another, it was hard work to carry it across the land between the two lakes. The Indians tried to find some way of making boats that could be carried easily. So again they turned to the forest and learned how to make boats from birch bark. After they had found a big birch tree, the Indians made two cuts through the bark all the way around the trunk. One was about a foot from the ground, and the other seven or eight feet higher. Then two other cuts were made, straight up and down, on opposite sides of the tree. These connected the cuts running around it. Then the Indians carefully peeled the bark off, in two large pieces, each big enough for a canoe, which is the name for this sort of boat.

A birch bark canoe of the Indians.

Then came the making of the frame. The Indians took two branches of a cedar tree, tied the ends together, and bent them out in the middle so that they looked like two bows laid side by side. Cross-pieces

kept the frame in shape and curved ribs made the bottom of the canoe.

Now they were ready to put on the birch-bark covering. They folded it lengthwise, laid it around the frame, and after making it fit, they sewed up the ends with the long, tough roots of a tree. Finally, they made the canoe water-tight by covering the seams with a thick coating of resin from fir trees.

The Pilgrims doubtless had a hard time learning to balance themselves in Indian canoes. You probably know that when you get into a canoe you must be careful to step right in the middle. Otherwise you will be quite likely to tip over. Birch-bark canoes were harder to keep right side up than ours are. Often a colonist would buy a canoe from an Indian and set out by himself on the water. He no sooner got into the frail little boat than it turned over with him, and he disappeared in the water. The Indian must have laughed to himself as he fished the white man out. But soon the white men, too, learned how to use canoes, and our pleasure boats of today have been modeled from them.

The Eskimos of Greenland build kayaks, or hunting boats, much like canoes, but they use different things. They often have to use the bones of walrus and seals for the frame, because the only wood they have is driftwood, and there is not much of that. For the covering of their kayaks, the Eskimos stretch seal-skins tightly over the frame. They sew it to the frame with sinews of reindeer. You see how the Indians, who lived in the forests, used trees in building their boats, while the Eskimos, who live where

there are no trees, use the bones and skins of animals. Both use the materials which are at hand.

A kayak is usually about twenty feet long and two feet wide, and has very sharp ends. An Eskimo must be careful when he steps into one, for it upsets easily. Most kayaks carry only one man, and he makes the boat go by paddling with a double-ended paddle. There is a little opening in the skin covering of the boat near the middle, into which a man fits quite snugly, so that no water can leak in. A skillful Eskimo can roll his kayak over and over sidewise, but it must be very uncomfortable to dip his head into that icy water.

Boats of the Eskimos. Near us is a kayak, and farther away a umiak.

The Eskimo families go traveling in boats called umiaks which hold ten or twelve people. A umiak is built of bone and sealskin, like the kayak, and since no wood is used, it is put together without any nails. The pieces of bone are firmly tied to each other with strips of walrus hide. The umiak is

wide and blunt and is open, like our rowboats. Sometimes there is a mast with a sail at the bow, but usually the boat is rowed. It takes four people to row a umiak at all fast.

A boat that is long and narrow is easy to upset. The first men who made dugouts and canoes soon found this out. They made broader boats by lashing several logs together into a raft. Indeed, rafts may have been made even before dugouts. Even today there are places in the world where the natives use rafts, especially if they are going on long journeys on a river or if they wish to ferry their families and their goods across a body of water.

On the Amazon River in South America, travelers often see a raft with a thatched hut built upon it, in which the people live while moving to a new home. Among the East Indies, rafts that carry passengers have a round tub in the center. When the water is rough, the people sit in the tub. When it is smooth, the tub is used for stowing goods.

On the Tigris River, in Asia, goatskins blown full of air are tied underneath rafts that carry freight, to make them float better. To inflate the skin, or blow it up, a man ties up the neck and the holes where the goat's legs were and blows through a little tube just as you blow into a toy balloon or the bladder of a football. When the skin is full of air, the man ties a stout string tight about the neck. Small rafts need fifty goatskins, and the largest ones several hundred.

When people go on a long voyage on a raft, a sail is often used when the wind blows the right way. At other times, oars are used for rowing. If it is a ferry,

the raft is sometimes pushed with poles until the water gets too deep, and then it drifts with the current. Years ago rafts were a common sight on the Mississippi River floating downstream with the current, loaded with goods.

Perhaps you know the nonsense rhyme that begins:

"They went to sea in a sieve, they did —
In a sieve they went to sea."

Of course this would be a silly thing to do, but it would not be much better to try to cross a pond or a river in a boat like a clothes-basket. It would leak so fast that you would soon sink. If, however, you should coat your clothes-basket inside and outside with tar or pitch and allow it to dry hard, you would have a fairly good boat.

Koofahs on a river in India.

In Africa and in India there are places where the natives make boats in much this way. They are called koofahs. Some of the Indians in South America do the same thing. Their boats are called balsas.

To make a koofah, the people weave a strong basket from stout twigs and plaster up all the cracks. Some koofahs are made water-tight by a covering of ox hides. Some of the koofahs seen in Africa are so deep that when a man stands up in one, the sides come almost to his elbows. They are large enough to carry two or three horses, besides several men.

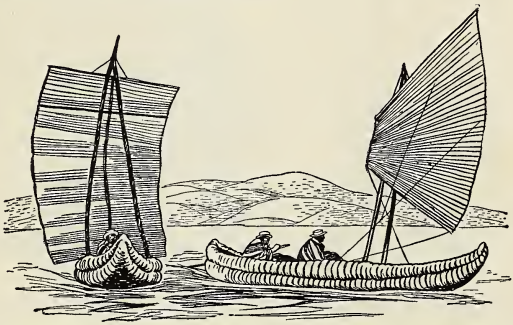
Two men, one on one side and one on the other, push the koofah out from the shore with long poles. When it gets out into the current, it whirls like a merry-go-round, but it can be steered fairly well with a broad paddle.

The balsas of South America are not exactly round. They have pointed ends that slope upward. They are built of bunches of dried bulrushes, tightly bound together. The men who build them make first a platform of these bundles, shaped as they wish the boat to be. Then they make a wall of other bundles along the sides. They put in a mast, shaped like a capital A, with a sail made of mats woven from bulrushes. The masts have to be built up from small pieces of wood fastened end to end, because in that part of South America, near Lake Titicaca, it is hard to find trees of any size with branches long enough for a mast. When there is not enough wind to sail these boats, the balsas are pushed through shallow water with long poles.

After a few voyages, a balsa is liable to be so thoroughly soaked with water that it will not float. Then it has to be dragged out on the shore and dried in the sunshine.

In other parts of the world, too, the natives have

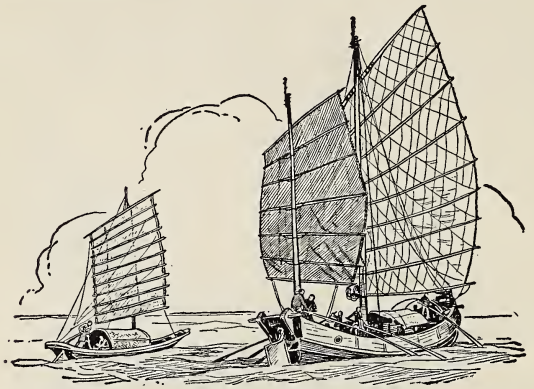
curious sailing vessels. Those in China are among the strangest of all. The ones built today are exactly like those built thousands of years ago, for the Chinese people are very slow to change their ways of doing things. Many of them think that their old-fashioned vessels are better than the kinds that visit China from other countries.



Balsas, the boats used by the natives on Lake Titicaca in South America.

There are probably as many boats in China as there are in all the rest of the world together. This is because there are so many rivers and canals in that country that boats are the commonest means of transportation. Thousands of people, too, live on their boats. They have no other homes. Long lines of sampans, as some of the Chinese boats are called, are always tied up along the banks of the rivers. Sometimes they are crowded together so close that no water shows between them. A sampan is a small open boat with one mast. As we see from the picture, it looks like a slipper. The little house in the center

is something like the part of the slipper that covers your toes. The roof is made of straw matting and curves over the boat from one edge to the other.



At the left is a little Chinese sampan, and at the right a big junk.

Sampans are used in fishing. The trading vessels of the Chinese are called junks. They have blunt bows, curving high above the water. Eyes are painted on the sides, for the Chinese have the idea that their vessels must see where they are going. Junks may have one mast, or two, three, four, or even five. Their sails are square, and usually made of matting, with six or seven slats running across from one edge to the other. The same vessel may have one sail colored red, another green, and another yellow.

The stern of a junk is even higher than the bow, and reaches far back over the water. There is a huge rudder, and most of it shows when the vessel is anchored in a shallow river. At sea the rudder can

let down below the junk's bottom, which is almost flat.

The color of the hull is usually brown. To protect the paint while the junk is being loaded or unloaded, matting is hung over the sides. The owners of these junks take great pride in their appearance. They often decorate the stern with pictures painted with bright colors.

There may be a deck over the whole length of the ship, or only a little one at the stern, with a sort of thatched house as shelter for the crew. If the rest of the junk is open, the cargo during a voyage is covered over with pieces of matting.

Chinese junks are probably the only vessels in the world that have been built in exactly the same way since five thousand years or more ago. Perhaps the first junks were the first seagoing vessels built anywhere.

Many people believe, however, that at about the same time the ancient Egyptians began to build boats for use on rivers. Boats like theirs are not built today, but we see many simple sailboats on the Nile River, which are not very different from those that were built in ancient times. We also see plenty of motor boats and steamboats, for the Egyptians have learned to make ships in modern ways.

The earliest boats on the Nile raised their sails when they went up the river, toward its source in the South. When they came back, toward the North, they could use only oars, but of course the current of the river helped them too. The only sails the ancient Egyptians knew how to make were square

ones running straight across the boat from side to side. Sailing was easy when the wind blew from behind, but when a boat tried to go against the wind, the sailors had to take down the mast and sails. The boats that the Nile fishermen use nowadays have triangular sails, and they can be sailed much as our pleasure yachts are.

Perhaps you have seen pictures of ancient Egyptian boats in which some men were standing up in the middle, facing toward the bow, and pushing back with big paddles just as you do in a canoe. Other men in the same boat might be sitting with their faces toward the stern, pulling on oars just as you do when you row a boat. The steering was done by one or two paddles dragging over the side near the stern.

Egyptian sailors made some voyages out into the Mediterranean Sea, but they did not dare go very far from land. One reason was that their boats were not very strong. There were few big trees in Egypt, and the boats had to be pieced together as firmly as possible from small pieces of wood.

The first men bold enough to travel long distances in their ships were the Phœnicians. These people lived not very far from Egypt, but in their country there were forests of fir, cedar, and oak. Thus they were able to build larger and stronger boats than the Egyptians could. Their vessels were called galleys. They made trading voyages to all the parts of the world that were known in those days. They used masts and sails when the wind blew. When it was calm, they rowed. Their oars were big and long, and

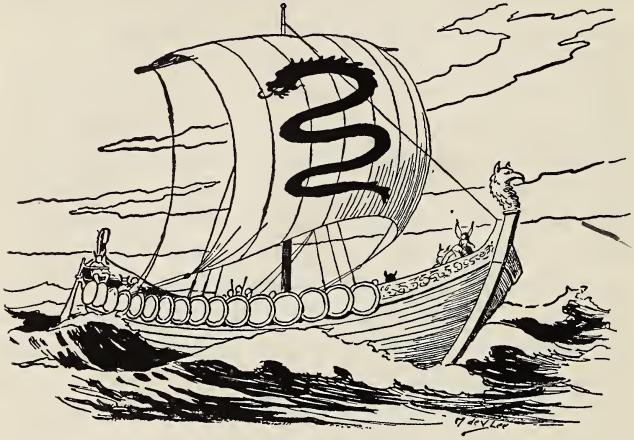
in some galleys they were arranged in two rows or even three along one side, one row above another. You can see that the more men there were to pull on the oars, the faster the galley could travel.

The Greeks and Romans built ships much like those of the Phœnicians. You can read about their galleys and their adventures at sea in Hawthorne's *Wonder Book*, and Josephine Preston Peabody's *Old Greek Folk Stories*. Perhaps you already know the tales about the Trojan War and the wanderings of Ulysses, or those that tell of Jason and his quest for the Golden Fleece, or Theseus and how he slew the Minotaur. In the Bible there is a story about the ship in which Saint Paul started to go to Rome, and how it was wrecked.

We are especially interested in the Vikings, or Norsemen, because they were probably the first people who made voyages to America. They lived in the part of Europe that now forms the countries of Sweden, Norway, and Denmark. Some of them were pirates and often raided the shores of England and France. Some of their boldest sailors are said to have sailed across the Atlantic almost five hundred years before Columbus did.

Here is a picture that shows how the ships of the Vikings looked. You will see that they were long, open boats, curved up at the bow and at the stern, with big square sails. When the ship was sailing, the warriors hung their shields along the sides. When the wind died down, oars were run out, and some of the crew rowed. The boat was steered by a broad oar, or steer-board, let down on the right-hand side.

That is probably why our word starboard means the right-hand side of a ship.

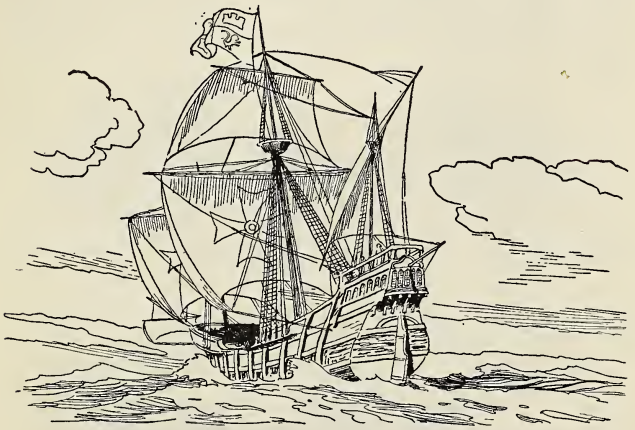


A Viking ship.

Hundreds of years after the Vikings, the people of England began to build platforms at the two ends of their ships. This was the beginning of decks. After many more years they built the ends up higher still, one deck above another, until there might be three or four decks at the bow and four or five at the stern. The ends of the ships towered above the water almost like castles, and that is the way the word forecastle came to be given to the space at the very bow of a ship. When you pronounce this word, you must be sure to say "fok'sl" unless you want a sailor to laugh at you. On a modern ship, the part where the crew lives, up in the bow, still has this old name.

This picture of one of the ships of Columbus shows

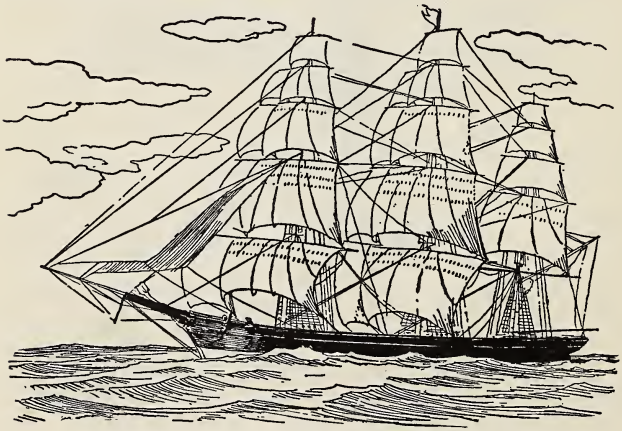
you how high the bow and the stern were in those days. The Spanish made their castles taller than the shipbuilders of other countries did. As sailors made longer and longer voyages across the Atlantic and the Pacific, they found that ships built in this way were liable to be blown sideways when the wind blew strongly against their sides. After a great many years, therefore, the tall castles at the ends were given up. Ships were built like ours of today with level decks their whole length.



The Santa Maria, the flagship of Columbus.
The biggest modern steamships are nearly eleven and a half times as long as the Santa Maria. They can carry nearly three hundred times as heavy a cargo as the Santa Maria could.

The best and most beautiful ships that ever sailed the seas were the American clipper ships of about seventy-five years ago. Here is a picture of one of

the most famous of them. You will remember that something has been said about these ships in the chapters in this book that tell about the Pullman cars and the airplanes named in honor of them. They were used to carry passengers and freight between America and Europe, and from New York around Cape Horn to California, or China, or Australia. There were many splendid English clippers, too, but they were smaller than ours. Many of them carried cargoes of tea from the Far East to England and others took settlers to Australia. You will find stories about clipper ships and their voyages in the books listed on page 432.



The beautiful clipper ship, Flying Cloud.

In those days steamships were even rarer than sailing vessels are now. Almost everything that was carried by water went either in a full-rigged ship, a

bark, a brig, or a schooner. We still see some of these in our ports, but there are about ten times as many steamships as there are sailing vessels.

Do you know how to tell the different rigs apart? Let us begin with the ship, which has the most interesting rig of all. You are not likely to see one very often in an American port, because nearly all of the full-rigged ships now sailing the sea belong to Norway or to Sweden. Now and then a newspaper tells about a voyage made by some old windjammer, as these vessels are nicknamed, so you will want to know how they look.

These drawings show the arrangement of the sails on a full-rigged ship, and on a bark.

A full-rigged ship has three masts and square sails on each of them. By square sails we mean sails that are set so that they run across the ship, from one side to the other. The upper and lower edges of such sails are fastened to heavy spars, or yards. Each yard is fastened to a mast by its middle.

A bark is just like a ship except that it may have four masts instead of three. All but one of the masts have square sails. The mast nearest the stern has a sail like a schooner's. That is, on this mast there is a fore-and-aft sail, which means one held by spars

fastened to the mast by one end. This sort of sail is set so that it runs lengthwise of the vessel.

The bark rig was nearly always used on whaling vessels of the olden time, for the fore-and-aft sails on one of the masts made it easier for the vessel to turn quickly if she got among icebergs. One of the vessels that Admiral Byrd took to the Antarctic was a bark, but she had a steam engine as well as sails. Some barks are used today in the sugar trade between the Hawaiian Islands and San Francisco. Others carry grain from Australia to Europe.

A barkentine is a three-masted vessel with square sails on the foremast and fore-and-aft sails on the other two masts. Most of the barkentines now afloat are used in trading between England and Norway and Sweden, but there are some in the French fishing fleets that come across the Atlantic to the Grand Banks of Newfoundland. Some school ships are barkentines, but these always have engines as well as masts and sails.

These three vessels, from left to right, are a barkentine, a brig, and a brigantine.

A brig has only two masts, and both of them carry square sails. A brigantine also has two masts, but only the foremast has square sails. Brigs and brigantines are smaller and faster than three-masted square-

riggers. In the old days they were sometimes used by pirates and smugglers, but most of them were traders. They needed fewer men to sail them, of course, than the big ships and barks did.

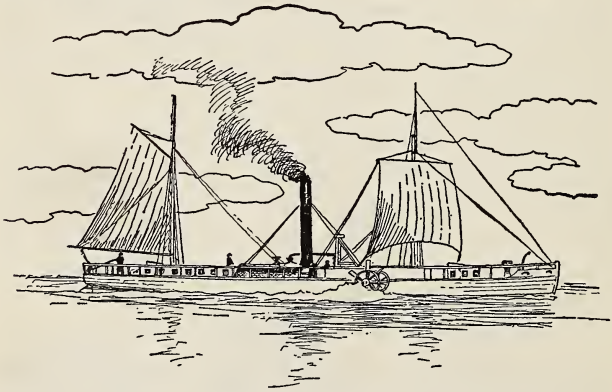
The commonest American sailing vessel is the schooner. We are not counting sloops and catboats, because they are used for play, not work. A schooner may have two, three, four, or even more masts, all of which are fore-and-aft rigged. A two-masted schooner is the commonest type of fishing boat, and she nearly always has an engine so that she need not be becalmed when the wind fails. The larger schooners are likely to carry coal, ice, or lumber between ports of our own coasts. A sloop has only one mast, and so has a catboat.

Perhaps you are wondering why there are so many different rigs for sailing vessels. Why shouldn't all of them be either square-rigged or schooners? The reason is that square-riggers are better adapted to long voyages out to sea, while fore-and-afters are better suited to voyages along the coast.

Full-rigged ships call for a large crew because their square sails have to be set and furled by men who climb out on the yards. Fore-and-aft sails can all be worked from the deck. Vessels that carry them need smaller crews. That explains why shipbuilders invented such rigs as the bark, the brig, and their little sisters. Last of all the schooner was invented for use along the shores of the English colonies in America.

There were no steamships in the world until about one hundred and twenty-five years ago. About the time when George Washington became President, an

American named John Fitch had experimented with a steamboat that worked by paddles. The machinery dipped them into the water much as a person paddling a canoe does. This boat was not a success. In England other men had tried a boat with a paddle wheel at the stern. But the Clermont, built by an American, named Robert Fulton, in 1807, was the first steamboat that worked well. She steamed up and down the Hudson River, but never went out to sea. She had a big paddle wheel on each side. This picture shows how she looked.



Fulton's Clermont.

One of the ladies on the Clermont on her first trip wrote a letter about it in which she said, "The passengers bade their friends farewell with as much anxiety as if they were going to Madagascar. They trembled at the thought of the terrible risk in sailing in a boat full of fire." Within a few years, however, people learned that steamboats were not dangerous after all.

The first ship to use a steam engine on the ocean was built by Americans, twelve years after Fulton's Clermont. She was the Savannah, a vessel that had at first been a sailing ship. A steam engine was put into her, and it was used part of the way on her voyage to England. When the Savannah was not steaming, she hoisted her paddle wheels on board and used her sails.

This ship proved that engines could be used on rough water out of sight of land just as well as on the smooth waters of a river. After that, more and more steamships were built. As time went on, they took the place of the clipper ships and the other sailing vessels. For many years they had masts and sails because people were afraid the engines might break down.

For a long time all steamers were side-wheelers, which means that they had a big paddle wheel on each side. At last an American invented the screw propeller, which nearly all steamships, large and small, now use. Since then, some of our river and lake steamers have been the only ones to use the old-fashioned paddle wheels. Perhaps you have seen a towboat on the Mississippi, with one huge paddle wheel at the stern.

You will find it interesting to hunt up pictures in books that tell about ocean liners. Perhaps you can make a collection of your own, for most of the great steamship companies will be glad to send you pictures of their new vessels. Sometimes they have pictures of older ones, too.

The men who thought that the first ocean liners

were so wonderful would hardly believe their eyes if they could see the Manhattan, or her sister ship the Washington, and the other great steamships of our day.

WHAT TO READ

The Book of the Sailing Ship. Stanley Rogers.

Chapters XVIII. Modern Windjammers; XXI. How Our Great Grandparents used to Travel.

"The Cape Horn Grain-Ship Race." A. J. Villiers. *National Geographic Magazine*, vol. LXIII, no. 1, Jan., 1933.

"From Galley to Steamer." J. J. Hagerty. *Home Geographic Monthly*, vol. 1, no. 7, Jan., 1932.

Historic Ships. R. S. Holland.

Chapters I. Ships of the Ancient World; XXII. The Clipper Ship; XXV. Ships of the Modern World; XXIX. Ships of Various Types.

"The Last Great Fleet of Windjammers." A. J. Villiers. *Travel Magazine*, vol. LIX, no. 3, July, 1932. Pages 22–25.

"Ship Ahoy!" G. F. Dow. *Home Geographic Monthly*, vol. 1, no. 11, May, 1932.

Ships. F. C. Bowen.

Chapter III. Under Sail (an imaginary voyage).

The Story of the Ship. Gordon Grant.

Large colored pictures of all sorts of ships, ancient and modern.

The World We Live In and How It Came to Be. Gertrude Hartman.

Chapters III. The First Boats; XVI. The Conquest of the Waters.

THE WORLD IS GROWING SMALLER

WE HAVE now come to the end of our imaginary journey. We have crossed oceans and continents and have had glimpses into many strange corners of the earth. What interesting things we have seen! How many ways of traveling and of carrying goods there are! And yet men and women in foreign lands do not differ from ourselves so much as we sometimes think they do. They may not use automobiles, and they may never have seen an airplane or even a railroad train. They work in ways that seem queer to us, they raise different crops, and they live in different kinds of houses. Their clothing and their food, too, are not the same as ours. But they are all fond of their homes and their own ways of living. They love their families and their children. Most important of all, men and women everywhere wish to live peaceful lives. Like ourselves, they wish to be friendly with neighbors and visitors. Today it is possible for us to know a great deal about other lands because the new means of transportation, especially airplanes and dirigibles, are making the world a very small place. Every country is now a near neighbor of every other. Surely everyone wishes to have friendly neighbors. The more we know about them, the more friendly we shall feel toward the people of all the countries of the earth.

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